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ABSTRACT

The Iowa High School Curriculum Project was initiated to improve secondary industrial arts programs in Iowa. Phase I of the project addressed the following objectives: (1) completion of a review of courses, topics, concepts, skills, and attitudes currently taught and considered desirable to teach in secondary industrial arts programs; (2) prioritization of these factors for subsequent development of instructional modules and materials; (3) development and description of criteria for use in the creation of instructional modules appropriate to the secondary industrial arts curriculum; and (4) dissemination of descriptions of current industrial arts programs found to exemplify the goals, objectives, content, and instruction desired in the high school industrial arts curriculum. To accomplish these goals, researchers conducted a comprehensive review of literature pertaining to industrial arts curriculum development. In addition, they administered three surveys to Iowa industrial arts teachers to assess the basic concepts existing throughout industrial arts curricula and to identify courses and topics currently taught by Iowa industrial arts teachers. Recommendations emerging from the study included calls for reduced emphasis on semi-skilled trades and crafts, coverage of all major components of industry, and articulation of industrial arts instruction with other secondary subject areas. (Appendixes include state guidelines, textbook categorization, survey instruments and analysis of results, and discussion papers.) (MN)

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The Iowa High School Curriculum Project

Report on Phase I

A Descriptive Study

For the
Iowa Department of Public Instruction

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High School Industrial Arts Curriculum Project

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Final report: Phase I

The High School Industrial Arts Curriculum Project

William G. Miller

I. Forward

The High School Industrial Arts project of the Iowa Industrial Arts Cadre was initiated to effect curriculum improvement in the secondary industrial arts programs in the state of Iowa. This report summarizes the activities and results of Phase I of a five year project.

II. Purpose of Phase I

Phase I is considered the research phase of this project. The following objectives were stated for this phase:

1. Completion of a comprehensive review of courses, course units, topics, concepts, skills and attitudes currently taught and considered desirable to teach in the high school (secondary) industrial arts program.
2. The identification and description of underlying common dimensions within the content of existing and desired industrial arts that may form a theoretical basis for a comprehensive high school industrial arts program.
3. The prioritization of topics, content, skills and attitudes for subsequent development of instructional modules and materials.
4. The description of goals, objectives and conceptual dimensions or framework of the high school industrial arts curriculum consistent with the "Iowa Guide for Curriculum Improvement in Industrial Arts, K-12".
5. The development and description of criteria which may be used in the subsequent development of instructional modules appropriate to the high school industrial arts curriculum.
6. The dissemination of descriptions of current industrial arts programs found to best exemplify the goals, objectives, content and instruction desired in the high school industrial arts curriculum.

The above objectives form the basis and organization of the results of this report. The results section is reproduced in sections which hopefully facilitate their use in Phase II of the project.

III. Major Goals of High School Industrial Arts

Various authors and references enumerate goals of industrial arts. A representative list of goals include:

1. Provide opportunities for all students from elementary through higher education to develop an understanding about the technical, consumer, occupational, recreational, organizational, managerial, social, historical, and cultural aspects of industry and technology. (Sec. 1, page 10).
2. Students will acquire industrial-technical knowledge and competencies through creative problem-solving learning experiences involving such activities as experimenting, planning, designing, constructing, evaluating, and using tools, machines, materials and processes. (Sec. 1, page 10).
3. Awareness and exploration of aptitudes and interests in terms of potential for future careers. (1, page 12).
4. Development of knowledge, skills, and attitudes relating to industry and its supporting technologies. (1, page 12).
5. Work with the elements of industry and technology to gain understanding of how they function in producing goods and services. (2, page 9).
6. Understand the interdependence of society, industry and technology. (2, page 9).
7. Explore the context in which industry and technology has developed and continues to develop. (2, page 9).
8. Explore occupational areas as a basis for selecting a career and understanding the pursuits of others. (2, page 9).
9. Prepare for entry into appropriate industrially related occupations and develop a base for futher occupational education. (2, page 9).

10. Education in those elements of technology directly related to industry. (3, page 3).

The above sample of general goal statements generally embody cognitive, affective and psychomotor objectives to:

a. Provide career knowledge, career exploration skills and positive attitudes toward a large spectrum of potential employment levels.
b. Develop specific knowledge, skills and attitudes in the use of representative industrial tools.
c. Achieve an understanding of the total characteristics of industry including motivations, organizations, processes, products and personnel employed in industry.
d. Acquire knowledge of the technological bases of industry including scientific knowledge and its application to the design and production of useful products.
e. Achieve an understanding of the role of technology and industry in society and their effects on individuals in this society.
f. Experience satisfying work activities representative of industry to create positive interest and motivation toward work in industry-related occupations.

The above 6 (a-f) statements provide the basic goal statements employed in the completion of this project. It is from this set of goals that specific enabling and terminal objectives for secondary industrial arts programs will be generated.

IV. Problems in High School Industrial Arts Curricula

This secondary industrial arts project has its roots in the perception of many industrial arts teachers and teacher educators that substantial changes are required in industrial arts in order to make it responsive to rapidly changing needs of students and society. A number of specific problems which exist in secondary industrial arts have been identified in this study. They are:

1. Diversity. Because industry and technology encompass such a tremendously large body of knowledge, and skills not taught in other school subjects, courses developed within various schools, districts, and states that depart from the traditional core of woods, metals, drafting and automechanics may have little in common. Courses in computing, photography, packaging, printing,, alternative energy, electronics, enterprise, research and development, etc. may spring into existance on the basis of teacher interest and student interest alone. All such courses legitimately provide instruction on some aspect of industry. The problem is that such diversity in curriculum may lead to a myopic view of industry as a whole and produce serious discontinuity in programs when personnel turnover occurs. Courses developed to serve a transient interest may be costly to the school. In addition to the diversity in course offerings, there is even more diversity in the quantity of topical coverage. Some schools offer as many as three years of woodworking, metals, drafting and automechanics yet ignore electronics, graphics, energy, management, etc.
2. Resources. Industrial arts programs at the secondary level

vary widely in the resources available to teach industrial arts. A major resource is, of course, the student. School size, geographic location, competing academic program offerings, guidance facilities, laboratory facilities and program reputation all affect the number, sex and quality of students seeking enrollment in industrial arts. The number available to enroll determines the variety and nature of course offered. Since there has been little agreement concerning what constitutes a "core" of secondary industrial arts subject content, what often is offered is "what is fun to teach and fun to take".

3. Inertia. In spite of rapid changes in technology and industrial practice, many programs have been virtually unchanged from those promulgated by Woodhouse of St. Louis, Missouri in 1890. A number of factors contribute to this inertia to change including public expectations, school administrators, teacher education programs and teachers themselves. Program changes require time, energy and usually money. Teachers require up-grading of skills through in-service training and advanced degree preparation. Laboratories require additional equipment and materials. Students require new instructional media (books, films, etc.). School administrators, guidance counselors, school board members and parent/teacher associations require education and information to understand the changes. All of these impediments to change may be overcome if the I.A. teachers themselves are highly motivated. In many instances change have occurred.
4. Philosophy. The philosophical bases on which industrial arts

developed, including cottage industries, crafts and trades, early industrial need for skilled and semi-skilled workers and recreational needs, continue to influence the industrial arts curriculum. The rapid changes in agriculture, service industries, technical professions, and technology and science, however, have created a new set of pressing demands for education. Employment trends have changed drastically in the past 50 years. Advances in electronics, communications and media, transportation, organization of labor and production methods impact the future citizen and employee in a variety of new ways. The past twenty years has witnessed a movement to change industrial arts to become industrial arts and technology or simply industrial technology. This shift in emphasis to the technical aspects of industry away from the emphasis on the "art" or manual skills of the past has created disagreement within industrial arts as to the content emphasis and instructional methods to employ in teaching various topics. In addition to the arts vs technology issues, there is disagreement as to the degree to which industrial arts should be considered "pure" general education or pre-vocational education. It is clear that industrial labor covers a range of personnel from unskilled to professional preparation. Those with a "general education" philosophy stress that industrial arts needs to serve all future citizens, whether homemaker, professional, technician or unskilled. Those with a "prevocational" orientation stress preparation for entry into vocational programs, predominantly trades and industry vocational program. The

difference in these two philosophies may drastically effect the composition of students electing industrial arts courses and the content inclusion and emphases within those courses.

5. Continuity. At the secondary school level, industrial arts coursework is predominantly elective by students. Usually the courses offered do not require prerequisite skills obtained in previous industrial arts courses. Thus drafting may be taught quite independent of electronics, automechanics, or metal processing courses. The subject matter of industrial arts appears to be unrelated, fragmented pieces of knowledge or skills with little commonality or heirarchical acquisition of knowledge. When one examines the diversity of course offerings and content across school systems, the non-existance of a cumulative, ordered body of knowledge becomes even more apparent. "Graphic Communications" in school (A) may cover drafting, printing, photography, design, airbrush, and computer graphics while in school (B) includes primarily machine and architectural drafting only. There is no discipline in the "discipline" of industrial arts.

6. Methodology. Not only do the topics and topic emphasis vary widely from program to program but the methodology to teach the subject matter varies widely. Some I.A. instructors favor a strong "project" orientation and their courses consist almost entirely of constructing individual products. Other instructors favor a "skills" emphasis and have students perform a wide variety of standard psychomotor activities. The "concepts" oriented teacher attempts through lecture, demonstration and group projects to teach operations

concepts applicable to a wide variety of materials and machines. There is variance among teachers on emphasis of good "product" development versus learning industrial "processes". More traditional courses in woods, metals and drafting tend to emphasize high quality product (project) achievement by students. Newer courses in "enterprise system", manufacturing, computing and alternative energy systems place more emphasis on the concepts, processes and systems employed in production of commercial products. This variance in methodology creates problems in curriculum planning in that teachers may react negatively, not to the topics included, but the method proposed for delivery of the topic.

7. Social/Psychological. The curricula in industrial arts have been predominantly male and "blue collar" in orientation. With content emphases on trades and materials processing and semi-skilled occupations such as automechanic, draftsman, cabinetmaker and carpenter, there is little appeal to the future engineer, dentist, teacher, biologist, homemaker, salesperson or manager. As a consequence, I.A is often a "dumping ground" for students considered unfit for anything but unskilled or semi-siilled work. Clearly (and proudly) I.A. does have much to offer students unsuccessful in traditional academic subjects. But it cannot be maintained that I.A. is general education if, by content, it applies to only a strata of male students. Not only would curriculum need to change to meet needs of all students, but the facilities in which it is taught and the method of teaching used would need to be changed to attract females and preprofes-

sion students. The guidance counselor and school principal as well as other subject teachers would require extensive reorientation to an updated industrial arts program to prevent continuation of a male dominated, blue collar perception of industrial arts.

8. Change. The rate of technological advances has been documented as an exponential growth in knowledge and processes. Much of the newer technology involves expensive, complex equipment. Few school systems can afford such equipment (with notable exceptions such as microcomputers). More important, few I.A. teachers have time or resources to acquire new knowledge, skills and experiences needed to teach current technology concepts. Finally, the volume of technological innovations occurring makes it very difficult to select those aspects of technology which best demonstrate important new concepts and methods in which every citizen should become familiar. The resulting frustration results in the status quo.

9. Overlap. Those schools in which graphic communications, computer technology, management systems, alternative energy or other new courses have been introduced within the I.A. curriculum are experiencing a rather novel situation. These courses frequently deal with content shared with art, mathematics, business education, science, chemistry, physics and distributive education curricula. What might be viewed as a rare opportunity to integrate education into a meaningful whole may instead produce territorial battles for equipment, course placement, students and personnel. Is alternative

energy technology a subject for science, physics or industrial arts? Are computer applications in industry such as computer aided design, word processing, payroll production, assembly automation, market analysis and product testing in the domain of art, secretarial science, business education or industrial arts?

10. Education. College programs preparing teachers of industrial arts vary widely in their conceptualization of what the I.A. teacher should know to be a successful teacher. "Manual Arts" is still used as a term in some programs while "industrial technology" has replaced even industrial arts in others. Programs at the college level also vary in the "skills" emphasis versus "concept" emphasis. Since teachers usually teach high school in a manner similar to their own I.A. instruction at the college level, it is not surprising that wide variance in practice is observed in the public school programs. The level of beginning teacher salaries in contrast to industrial salaries, the lack of systematic technical updating programs, the cost of returning to college campuses for further education and the complexity of the subject matter itself all contribute to this education problem. Curriculum in industrial arts will usually reflect the skills and knowledge of the teacher. The problems of education therefore directly affect the curriculum.

11. Curriculum. In addition to the problems of diversity, methodology, continuity, education and philosophy in industrial arts, there is a group of problems related to the content itself. The grade level (student readiness) at which topics

are introduced has not been systematically studied to determine the optimal level for acquisition and retention. The organization of topics in a manner that reinforces prior learning, fosters understanding at higher cognitive levels and which maintains maximum student interest or involvement has not been investigated. The methods to teach students widely divergent in rates of learning, interests, handicaps and future educational goals has not been specifically addressed in the I.A. curriculum development. Finally, the means for integrating the learning activities in the I.A. curriculum with coursework taken in other subjects in a preplanned, coordinated way have not been developed.

12. Evaluation. Student, faculty, curriculum and facilities evaluation in a manner which permits qualitative comparisons among programs has not been developed to an adequate degree. State guidelines for I.A programs are generally so permissive that virtually anything taught, to whatever level selected, by whatever method selected are acceptable. Recent developments by the Standards for Industrial Arts Programs Project (4) suggest a set of criteria for evaluating I.A programs. In addition, standards and guidelines have been proposed for accrediting undergraduate and graduate teacher preparation programs (5). These standards will aid in assuring some degree of professional concern in program development with I.A. department. Unfortunately, these evaluation standards are not prescriptive in providing direction for curriculum content, emphasis, sequence and method. No standards exist which specify what an informed citizen or high

school graduate should know about industry and technology. There are no standardized tests of student achievement in the area of secondary industrial arts. There are standardized vocational tests in the trade areas. Until we can specify what students should learn in I.A., it will be difficult to develop useful indicators of program adequacy in terms of effecting desired student learning.

13. Financial. Learning that knowledge and skill which improves the liklihood of eventual successful employment in an industrial/technological society would seem to be as "basic" an education as reading, writing and arithmetic knowledge acquisition. Yet constriction of financial support in public schools frequently places I.A. programs in a "first-to-go" situation. Because I.A. curricula are frequently taught as "hands on", individualized courses, their per pupil costs are higher than competing courses. This suggests that lower-cost alternatives to teaching I.A. be found. Larger class enrollments, less expensive equipment and material usage and greater usage of self-instruction materials may be alternatives to consider. In any event, financial constraints impose a significant curriculum development parameter.

V. Methodology of Phase I

Methods used to complete the six objectives stated in section II may be grouped as (1) Review, (2) Emperical and (3) Conceptual. The following is a description of each.

1. Review of Literature Methods. Five sources of information were identified as "target" sources to meet objective 1. These were:
   a. State department guidelines and bulletins on industrial arts curricula.
   b. Textbooks available for use in secondary industrial arts.
   c. Data collected by Virginia Polytechnic Institute staff for the Standards Project.
   d. Professional journals in industrial education providing articles related to curriculum development.
   e. Published or unpublished documents related to previous industrial arts curriculum projects.

State department guidelines from (a) above were solicited from each state's department of public instruction. (22) guidelines were received from the 50 states surveyed. Each guideline was then abstracted to identify the content areas and topics recommended for inclusion in industrial arts (see Appendix A).

Textbook publishers providing industrial arts text books were surveyed to obtain free copies of books currently used in secondary I.A. programs. From the publishers contacted, (5) responded with a selection of texts. A total of (145) books or pamphlets were received. These were then abstracted by listing chapter titles. A summary of titles classified by "clusters" is presented in Appendix B.

The Standards for Industrial Arts Programs had completed a nationwide survey of industrial arts personnel on a sampling basis to identify the kinds of courses and programs available in Industrial Arts. A portion of that project was to provide computer files of collected data to other I.A. researchers. However, personal correspondence by Mr. Dugger, the project director, indicated they had "accidently" erased all their computer tapes. Summary aggregate data reports published by that project were therefore utilized.

The ERIC search facilities of the Library at Iowa State University were utilized to seek articles in educational literature dealing with curriculum issues in industrial arts education. A bibliography of articles obtained in this search may be found at the end of this report.

State and national curriculum projects such as the Maryland Plan, Industriology, IACP, etc. provided a rich source of information on past curriculum efforts, theoretical orientations and implementation efforts.

2. Empirical Procedures. Survey questionnaires were completed and administered to industrial arts teachers in Iowa to:
   a. Assess the basic concepts which may exist throughout I.A. curricula and,
   b. Identify courses and topics currently taught by Iowa I.A. teachers.

A factor analysis and varimax rotation were performed on responses obtained in the first survey. Courses and topics were summarized from the survey in (b) above.

A third survey was constructed to obtain a rating from teachers,

school administrators and industrial managers on the relative importance of topics, topic levels of emphasis and instructional methods potentially included in I.A. that are not currently widely available. The ratings among these three population samples were compared and interpreted.

A fourth survey was completed to prioritize topics for development in secondary industrial arts. I.A. teacher educators and I.A. teachers were sampled from the Iowa populations. Topics included were those identified by the literature as appropriate for the Secondary I.A. curriculum and for which little published material appropriate to the secondary level I.A. program was identified.

3. Conceptual Methods Employed. Utilizing current and projected U.S. employment trends in employment, literature reviewed and emperical results from 1 and 2 above, a conceptual framework for industrial arts curricula were generated. This conceptual framework utilizes previously articulated "cluster" concepts, industry organization, levels of instruction, instructional methods, type of industry and primary energy source. These dimensions form the lattice for classifying I.A. material, delimiting the content of industrial arts and identifying knowledge gaps in I.A. curricula.

   A "Delphi" procedure was employed to obtain consensus among the Curriculum Advisory Panel for:

   a. Adoption of criteria to apply in the development of new I.A. curriculum materials and
   b. Prioritization of units for which to develop new materials, and
   c. Development of achievement tests in Industrial Arts subjects.

VI. Results of Phase I

Results of this project are organized according to the six objectives of the study. Where results are too lengthy to include without detracting from the understanding of the major findings, they are included in appendices.

Objective 1. Comprehensive Review of Current Industrial Arts Courses.

Twenty-three state guidelines for industrial arts were obtained from the fifty states. Each of these guidelines was examined for course or cluster, subject within course and topic within subject. Appendix A contains the recommended topics by state. In order to compile a list of course topics across state guidelines, five clusters were selected: (1) Graphic Communications (2) Power and Energy (3) Manufacturing (4) Construction and (5) Transportation. States varied in their "cluster" titles and subject inclusions hence the authors were required to develop "rationale" clusters which best represented the combination of states. This section reports the clusters, subjects and topics found in the combined state guidelines. The subjects listed within each cluster may conceptually constitute separate semester courses in larger programs or simply modules of instruction within a "cluster" course in schools with more restricted enrollments and offerings. The priority ratings reported for Objective 3 are based on these clusters and topics.

Objective 2. The Identification and Description of Underlying Common Dimensions Within the Context of Existing and Desired Industrial Arts that May Form a Theoretical Basis for a Comprehensive Industrial Arts Program.

Two approaches were utilized to identify the dimensions underlying industrial arts curriculum. The first involved development and administration of a 31 item questionnaire which asked I.A. teachers to indicate whether or not a particular characteristic was involved in most industrial arts courses. The results of this study are summarized in Appendix C. Six tentative dimensions were identified by empirical means:

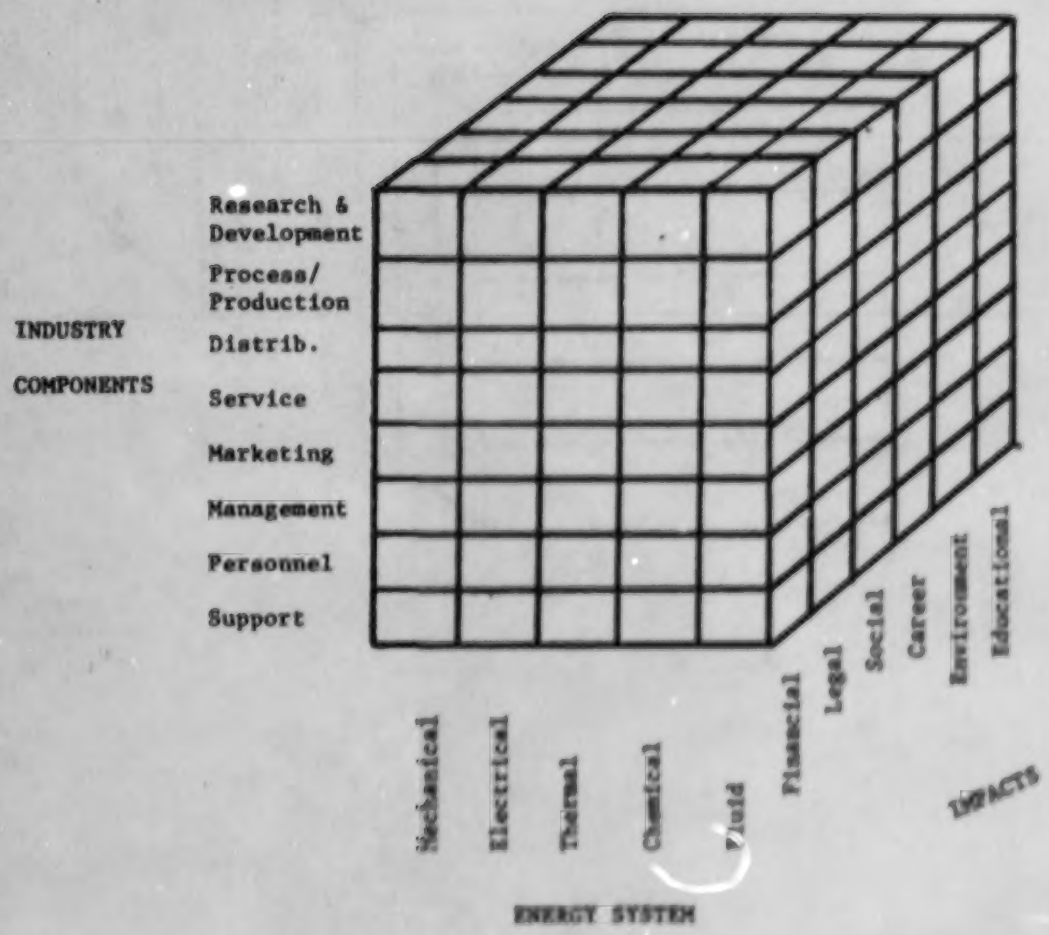
1. An emphasis on personal development
2. An emphasis on processing of materials
3. An emphasis on avocational uses of I.A.
4. An emphasis on technology
5. An emphasis on development of psychomotor skills
6. A differentiation in learning concepts versus skills

In addition to the empirically derived dimensions, six rationally derived dimensions were obtained through analysis of state guidelines, industrial literature, technology literature, curriculum theory textbooks and I.A. literature. These dimensions are:

I. Components of Industry
II. Energy Systems
III. Social Impacts of Industry and Technology
IV. Types of Industry
V. Degree of Specialization
VI. Mode of Learning

These six dimensions of industrial arts instruction encompass the content and methodology of instruction in the industrial arts curriculum. The intersection of levels on these dimensions may serve as guidelines for development and organization of the curriculum. Figure 1 provides a diagram which depicts these six dimensions and representative levels within each dimension. Of particular interest was the relationship of curriculum "clusters" often employed in structuring I.A. offerings to these six

Figure 1. Dimensions of Industrial/Vocational Education



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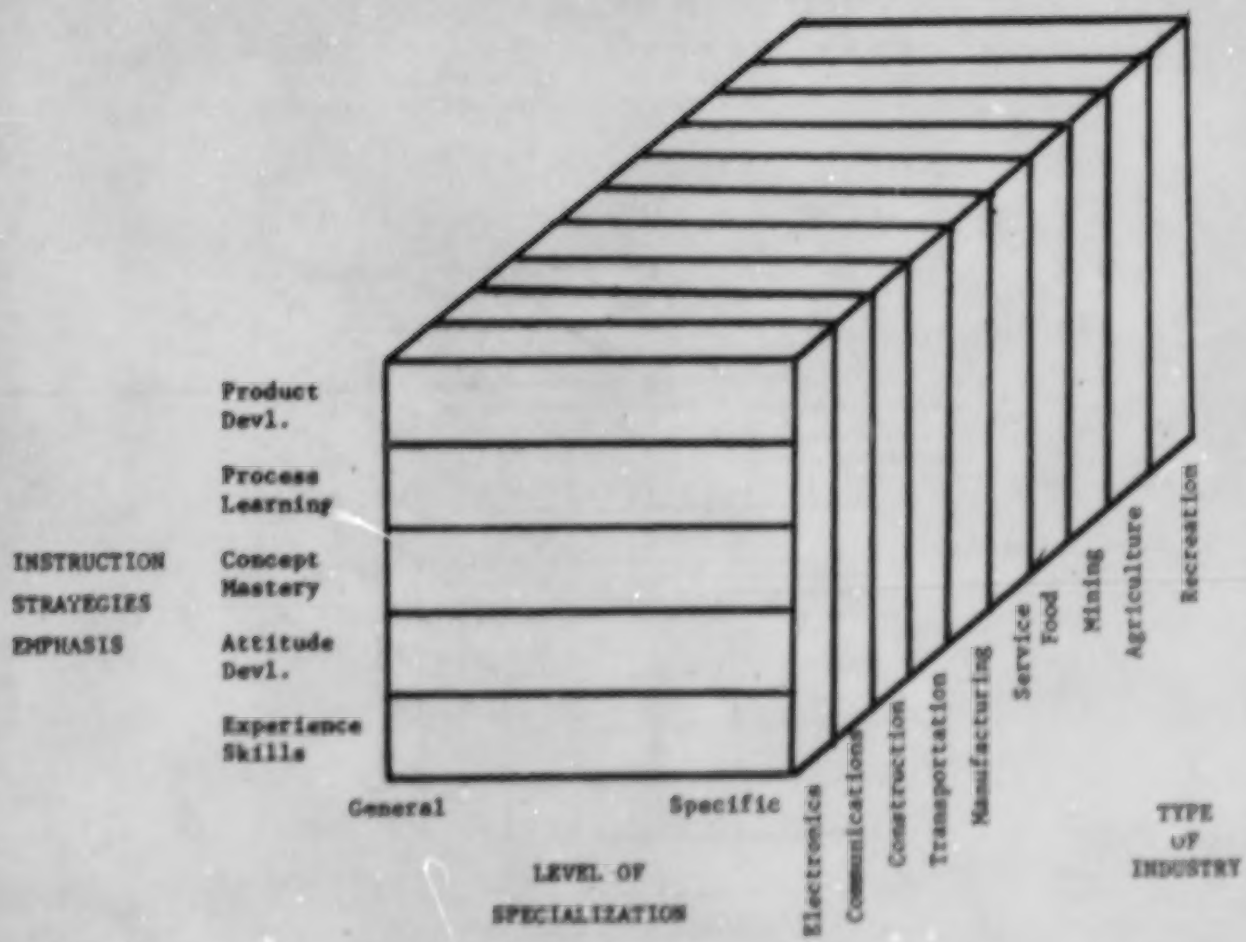


dimensions. Figure 2 demonstrates that the typical 3 to 5 clusters are essentially aggregations of levels in the "types of Industry" dimension (number IV above). There are notable difficulties with the "clusters" currently employed in I.A. curricula, that is, they exclude major types of industry such as agriculture, education, entertainment, recreational, service, textiles, etc. The "Types of Industry" dimension IV, on the other hand, encompasses all existing and emerging industries. Dimension IV may be conceptualized as a continuum of industries that vary in their "saturation" in materials transformation as opposed to human services. An arrangement of industries on dimension IV might be

Most materials oriented:
- Mining
- Manufacturing
- Construction
- Electronics
- Agriculture
- Transportation
- Communications
- Textiles (clothing)
- Service (repairs, maintainance, insur.)
- Recreation
- Entertainment
- Health

Least materials oriented:
- Education

The major philosophical issue of concern in industrial arts is whether or not to restrict the scope of the word "industry" to those industries concerned primarily with the application of science for transforming raw materials to finished products, or to teach <u>about</u> industry, whatever its major product or activity may be. It is clear that employment is expanding in those industries in which technology may replace human labor while maintaining production. It is also clear that the percentage of persons employed at the skilled and semi-skilled level is declining, while professional and technologist level personnel are in demand. Do we teach the skills of operating a 1920 lathe or do we teach the under-

standing of material processing as a small part of an entire industrial enterprise? This research report favors the latter. It is argued that "hands-on" learning may be used to facilitate the understanding of processes but that the quest for psychomotor skill development in the operations themselves is an inappropriate goal of industrial arts. Vocational programs, on the other hand, may appropriately focus on development of employment level skills in machine operations.

The discussion of types of industry covered in industrial arts has led to the discussion of the level of specialized skill to be acquired in any industrial activity. Dimension V is the factor which characterizes curricular material by the degree of specialization inherent. It may be roughly equated to a "general education to vocational preparation" continuum. For example, a third year course in automechanics would clearly be specialized education in one specific aspect (service) of one (transportation) industry and is strongly vocational in nature.

Dimension I of the conceptual model portrays major components of any industry. The principles underlying, for example, research and development in health, education, transportation, construction, or other industries are rather universal in nature. Conceptualization of problems, ideation of alternative solutions, market analysis, cost analysis, etc. are applicable to development of new computers or development of new health care delivery systems. Dimension I therefore provides a guide for curriculum development which spans the breadth of industrial activities. This dimension bears some resemblance to the divisions of industrial technology, i.e. management technology, production technology and personnel technology proposed in the IACP literature (6, page 84). This report favors a conceptualization based on a natural sequence of activities involved in the industrial process, that is, research and develop-

ment to maintainance services which are sequential in time for delivery of a given product or service.

Dimension II is a classificatory variable that focuses on the major energy system utilized in any particular industry type, industry component, social impact, etc. of the industrial/vocational curriculum model. Because products and services of industry often make direct application of scientific principles involving electrical, heat, mechanical, or other energy states, this dimension is useful for insuring that these principles are provided adequate coverage in the curriculum. An understanding of the role of energy systems in the design, production and delivery of products and services permits the integration of knowledge concerning science and engineering with management, processing and service content.

Dimension III of the model classifies curricular materials according to the impact industry has on financial, legal, environmental, social, etc. aspects of life. Since industry affects government policy, personal income, ecology and many other aspects of every citizen, it is important that students understand the interrelations among energy usage, types of industry, components of industrial activities and career specializations.

In order to characterize industrial/vocational education curriculum fully, the emphasis on the type of learning activities utilized to deliver skills and knowledge is included as a dimension of the curriculum model. Dimension VI is used to classify instructional delivery according to the primary mode of delivery. This instruction delivery may reflect an emphasis on knowledge, attitudes or skills and may utilize didatic through self-directed instruction. The utility of including this dimension is to insure a variety of learning materials adapted to student, teacher and school variations.

The conceptual model described above may be utilized for constructing a taxonomy of industrial/vocational education instructional materials and identifying topics for which additional materials are needed. As an example, we may select the intersection of the first level of each dimension to identify and instructional unit. We would have:

I. Research and Development
II. Mechanical Systems
III. Financial Impacts
IV. In Mining Industries
V. At general education level
VI. Concept lecture

Instructional material developed or identified in this unit would provide instructors with lecture materials on the cost aspects of equipment and processes of a mechanical nature considered for possible adoption in the mining industry. The problems of designing mechanical earth and mineral extraction equipment can be discussed and examples of recent technological innovations developed in the mining industry presented.

The utility of a conceptual dimensions model for curriculum development in industrial arts is measured by the degree to which it

(a) identifies key components inherent in curriculum such as content, delivery and order.
(b) identifies gaps or limitations in current models
(c) provides concepts unique to the discipline for which it is developed and is differentiable from other disciplines
(d) provides unambiguous and definable units of information.

It is felt that the conceptual dimensions model discussed herein satisfy these criteria. The authors recognize that it represents a departure from traditional course or cluster models which have guided past curriculum development efforts in industrial arts education. It does however build upon earlier conceptualization of the Ohio State Industrial Arts Curriculum Project, Paul DeVore's model (7), Everett Israel (8), and others.

To summarize, the following list of dimensions were identified as attributes which uniquely characterize industrial arts curricula:

1. An emphasis on personal development of students
2. An emphasis on processing of materials
3. An emphasis on avocational skill development
4. An emphasis on psychomotor skill development
5. An emphasis on knowledge about technology
6. The differentiation between learning concepts and skills
7. Instruction concerning different components of industry
8. Instruction on the application of energy systems in industry
9. Instruction on the social impacts of industry
10. Instruction related to the different types of industry
11. Recognition of varying levels of specialization in industrial knowledge and skills
12. Use of alternative instructional strategies

The latter 6 (7 through 12) are proposed as a framework for future curriculum development in secondary industrial arts.

Figure 2. Relationship of Curriculum Clusters to Theoretical Dimension IV, type of Industry

Dimension IV Levels	Five Cluster Levels	Three Cluster Levels
1. Communications	1. Graphic Communications	1. Communications
2. Service		
3. Recreation		
4. Education		
5. Entertainment		
6. Health		
7. Manufacturing	2. Manufacturing	2. Production
8. Mining		
9. Construction	3. Construction	
10. Textiles		
11. Agriculture		
12. Clothing		
13. Electronics	4. Power and Energy	3. Energy
14. Transportation	5. Transportation	

Figure 3 represents a conceptualization of the theoretical dimensions in the traditional input-process-output model with instructional strategies providing the mechanism for transforming "raw" knowledge into curriculum that results in desired terminal behavior of students. Only the degree of specialization dimension is not represented in this model.

Figure 4 also presents an input-process-output model with the process illustrating the transformation of basic concepts into applications resulting in desired outcomes.

It is clear that a number of conceptual models may be constructed that incorporate the basic dimensions and concepts of industrial arts.

Figure 3

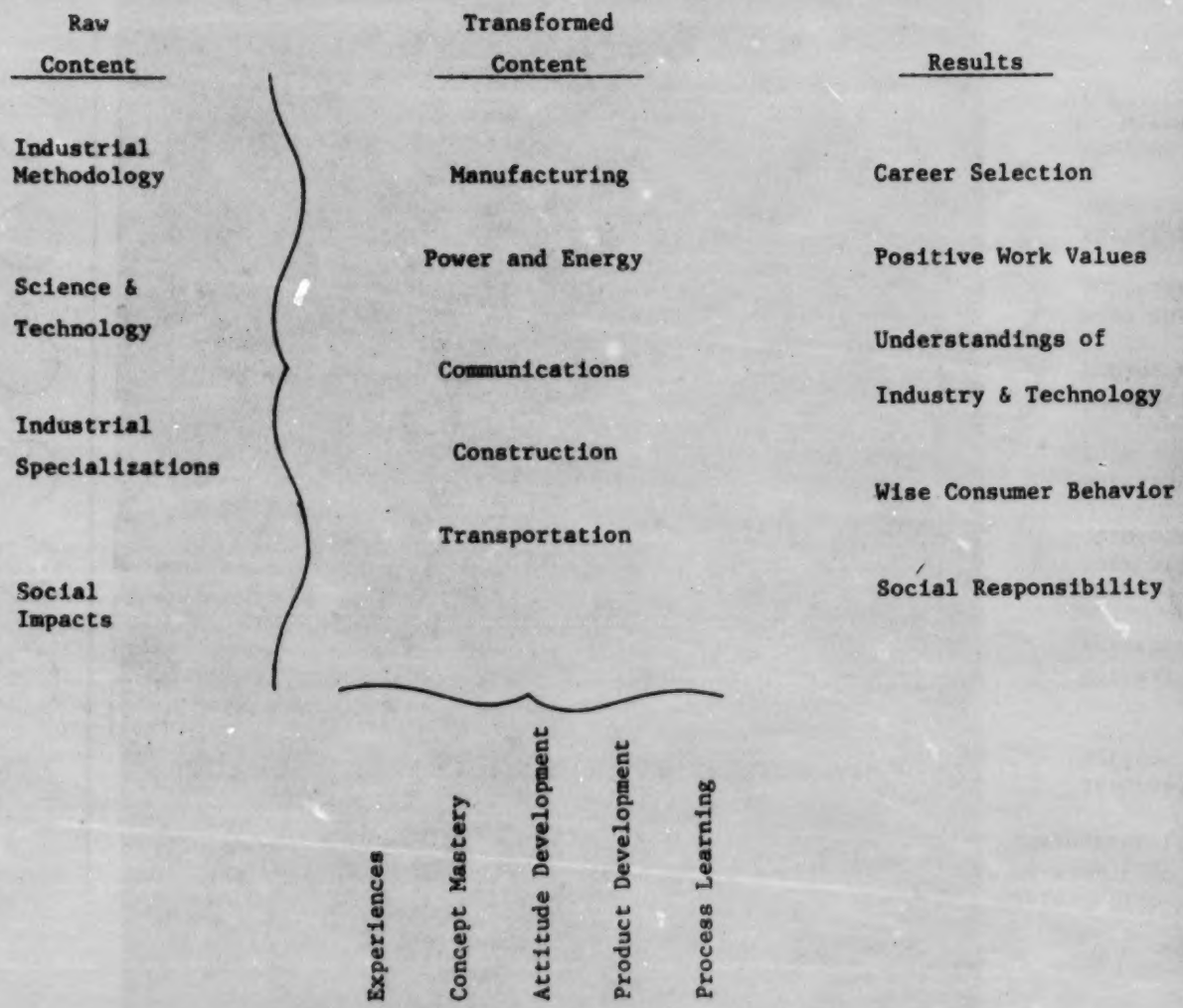
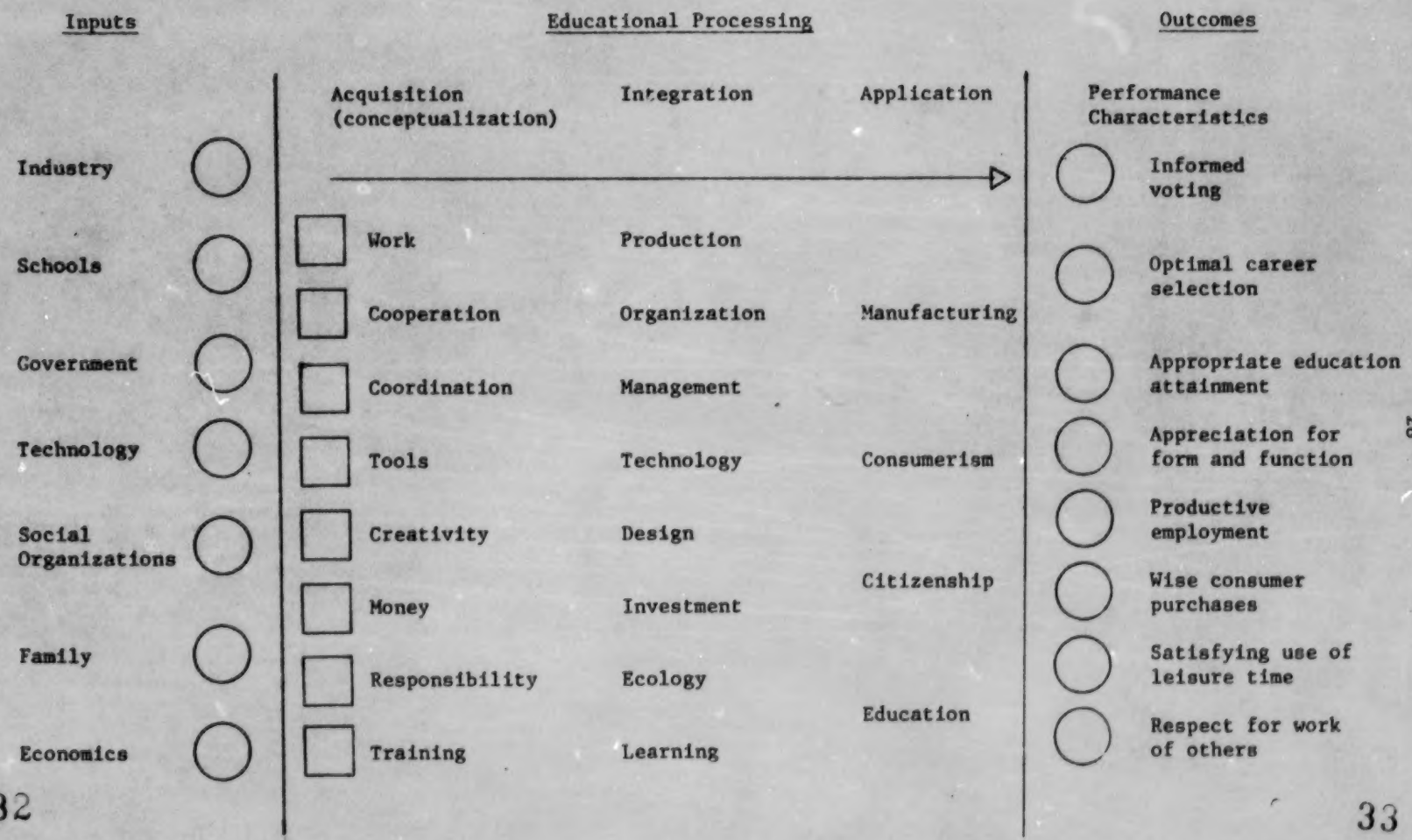

Raw Content
Industrial Methodology
Science & Technology
Industrial Specializations
Social Impacts
Transformed Content
Manufacturing
Power and Energy
Communications
Construction
Transportation
Results
Career Selection
Positive Work Values
Understandings of Industry & Technology
Wise Consumer Behavior
Social Responsibility
Experiences
Concept Mastery
Attitude Development
Product Development
Process Learning
Instructional Strategies

Figure 4


Inputs
Educational Processing
Outcomes
Acquisition (conceptualization)
Integration
Application
Performance Characteristics
Industry
Schools
Government
Technology
Social Organizations
Family
Economics
Work
Production
Cooperation
Organization
Manufacturing
Coordination
Management
Tools
Technology
Consumerism
Creativity
Design
Money
Investment
Citizenship
Responsibility
Ecology
Training
Learning
Education
Informed voting
Optimal career selection
Appropriate education attainment
Appreciation for form and function
Productive employment
Wise consumer purchases
Satisfying use of leisure time
Respect for work of others

Objective 3. Prioritization of Topics, Content, Skills and Attitudes for Subsequent Development

To determine priorities for development of instructional materials to supplement current materials used in high school industrial arts, the results of two analyses were utilized:

(1) Analysis of ratings to content areas within clusters by six groups of raters, and
(2) Analysis of current text materials available in Industrial Arts as supplied by publishers to the project.

The six groups surveyed to establish content priorities were:

1. Industry representatives randomly selected from the Iowa Association of Manufacturers.
2. High school industrial arts teachers randomly selected from a list obtained from the Department of Public Instruction.
3. High school principles randomly selected from the list of schools printed in the Iowa Educational Directory for 1980-81.
4. Industrial education teacher educators randomly selected from the Industrial Teacher Education Directory, 1980-81.
5. All members of the Curriculum Advisory Panel of the High School Curriculum Project.
6. Participating members of the Iowa Industrial Arts Cadre.

Figure (5) presents the results of responses to the survey instrument (see Appendix E) for ratings of the relative importance of the five clusters proposed in this study. In this figure, a profile line is indicated for the four major groups randomly sampled. The results indicate highly similar prioritization of the clusters for the four group results. Transportation and construction were rated lowest in importance. Tables (6) through (10) present the means and rank order of topics rated within each of the five clusters. Topics are presented in rank order according to the mean of combined ratings. Figure (7) presents the profile of total topic ratings within clusters and the previously presented cluster ratings of figure (6). The original 5 point scale used in topic ratings were converted to the 18 point scale used in evaluating the cluster im-

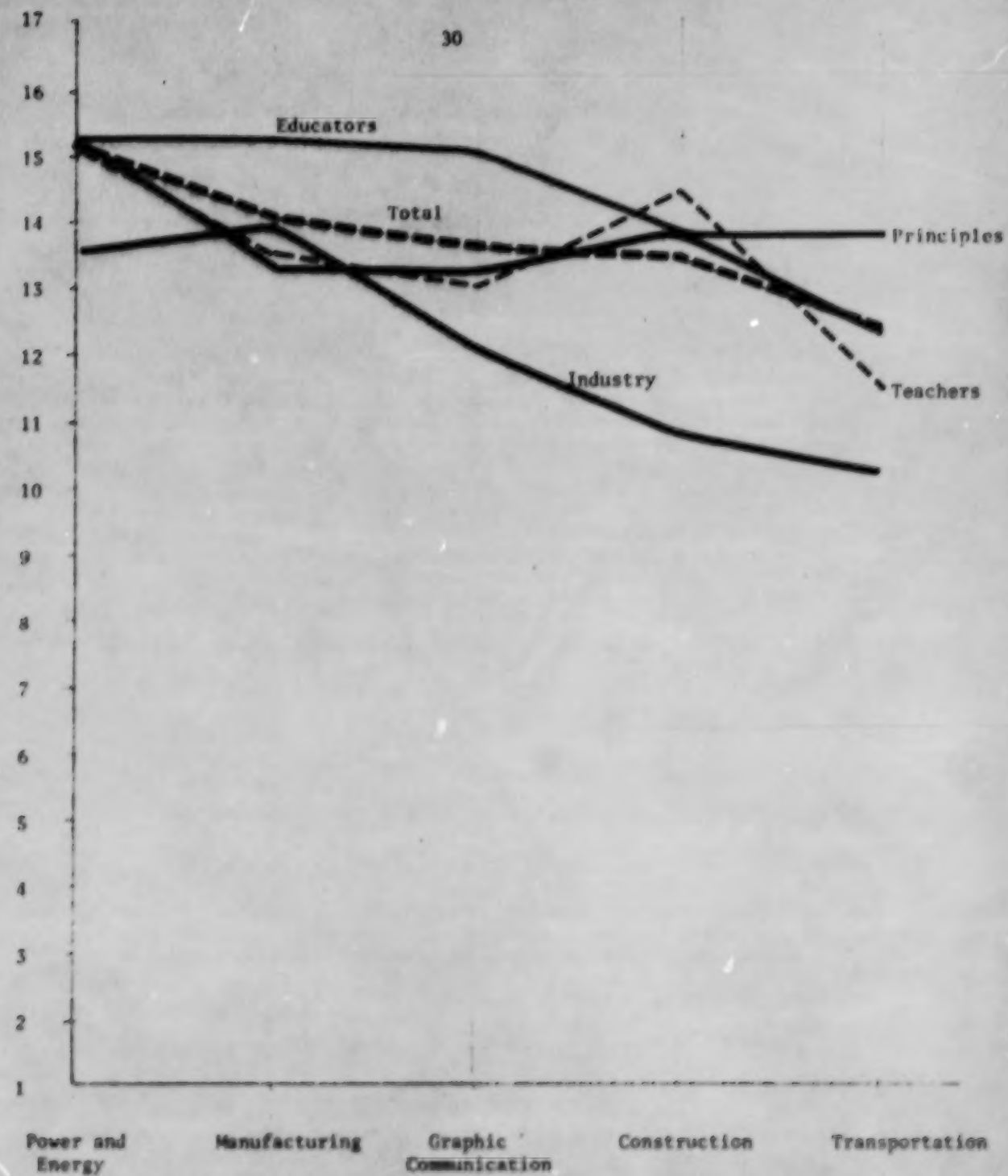


Figure 5. Ratings of Cluster Importance by Four Groups

portance. While topics within clusters were independently rated, it was felt the general elevation of average ratings within clusters should be consistent with the profile of cluster importance found in figure 5. The average converted topic ratings within clusters averaged 1.03 points below the average cluster ratings. For this reason, the average of each (rescaled) cluster had the value of 1.03 added in order to compare the profiles of cluster ratings and average ratings within clusters. Only one inversion of order occurred - that between manufacturing and graphic communications.

Figure 6

POWER & ENERGY TOPICS

ITEM DESCRIPTION	Industry		Teachers		Principles		Educators		Curriculum Advisory Panel		Cadre		Total	
	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R
Alternate energy sources and systems	3.82	5	4.20	1	4.19	1	4.46	2	4.33	4.5	4.22	5.5	4.22	1
Computer Technology	4.44	1	4.17	2	3.96	4.5	4.54	1	4.50	1.5	4.44	3	4.30	2
Principles of DC and AC	3.79	6	4.12	3	4.00	3	4.34	5	4.33	4.5	4.67	1	4.10	3
Principles of electronics	4.24	2	3.97	6	3.77	6	4.34	5	4.33	4.5	4.56	2	4.06	4
Basic energy and fuel sources	3.52	8	4.00	5	4.05	2	4.54	5	4.20	7	4.11	5.5	4.05	5
Digital electronics	3.83	4	3.74	7	3.43	8	4.38	3	4.50	1.5	4.22	4	3.83	6
Home service wiring	3.18	10	4.05	4	3.96	4.5	3.64	10	3.67	10	3.50	9	3.79	7
Communications applications	3.39	9	3.57	8	3.33	10	4.15	7	3.80	9	3.78	7	3.61	8
Industrial electronics	4.07	3	3.45	9	3.46	9	3.34	9	3.83	4.5	3.67	8	3.61	9
Hydraulics and pneumatics	3.72	7	3.35	10	3.55	7	3.97	8	4.17	8	3.33	10	3.59	10

Kendall's Coefficient of Concordance = .57, average spearman rank correlation = .48

Figure 7

GRAPHIC COMMUNICATIONS

ITEM DESCRIPTION	Industry		Teachers		Principles		Teacher Educators		Curriculum Advisory Panel		Cadre		Total	
	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R
Mechanical drawing and drafting	4.00	2	4.40	1	4.50	1	4.30	2	4.80	1	4.30	1	4.35	1
Computer graphics design, communications	4.30	1	3.90	4	3.96	4	4.54	1	4.50	2	4.66	1	4.12	2
Design principles	3.80	4	4.00	3	4.00	3	4.20	3	3.80	5	4.30	3	4.03	3
Architectural drawing and drafting	3.60	5	4.10	2	4.10	2	3.60	6	4.20	3	3.60	6	3.87	4
Circuit design and drafting	3.90	3	3.70	5	3.40	5	3.40	7	3.20	7.5	3.30	7.5	3.50	5
Photographic methods	2.80	6	3.30	6.5	3.40	7	3.90	4.5	4.00	4	4.20	5	3.45	6
Methods of printing	2.70	7.5	3.20	8	3.50	6	3.90	4.5	3.70	6	4.30	3	3.41	7
Radio and television production	2.30	9	3.30	6.5	2.80	8	3.30	8.5	3.20	7.5	2.90	9	3.06	8
The nature and history of communications	2.70	7.5	2.60	9	2.60	9	3.30	8.5	2.80	9	3.30	7.5	2.81	9

Kendall's Coefficient of Concordance = .76 Average rank correlation = .72

Figure 8

MANUFACTURING TOPICS

ITEM DESCRIPTION	Industry		Teachers		Principles		Teacher Educators		Curriculum Advisory Panel		Cadre		Total	
	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R
Materials Processing Machining	3.86	2	3.84	1	4.25	1	4.40	1	4.17	1	4.22	4	4.10	1
Product Assembly & Testing	3.63	4	3.68	2	4.05	2	4.16	4	3.50	7.5	4.22	4	3.88	2
Automated Manufacturing	3.96	1	3.47	3	3.54	5	4.25	2	4.00	2.5	4.00	6	3.75	3
Production Planning and Scheduling	3.83	3	3.36	5.5	3.80	4	3.96	6	4.00	2.5	4.22	4	3.70	4
Product Research and Development	3.55	5	3.28	8	3.82	3	4.09	5	3.83	4	4.40	1	3.66	5
Product Servicing	3.44	8	3.46	4	3.41	7	3.72	7	3.50	7.5	3.44	7	3.50	6
Purposes and Organization of industry	3.31	9.5	3.00	10.5	3.16	8	4.19	3	3.66	5	4.30	2	3.42	7
Acquisition and Inventory of Raw Materials	3.51	6	3.29	7	3.58	6	3.44	9	2.80	11	3.33	8.5	3.40	8
Product Marketing	3.45	7	3.36	5.5	3.01	9	3.26	10	3.50	7.5	2.89	10.5	3.27	9
Product Packaging	3.14	11	3.0	10.5	2.98	10	3.54	8	3.50	7.5	3.33	8.5	3.16	10
Distribution and Warehousing	3.31	9.5	3.03	9	2.80	11	3.05	11	3.00	10	2.89	10.5	2.65	11

Kendall's Coefficient of Concordance = .68 Average rank correlation = .62

Figure 9

CONSTRUCTION TOPICS

ITEM DESCRIPTION	Industry		Teachers		Principles		Educators		Curriculum Advisory Panel		Cadre		Total	
	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R
General Principles of Construction	3.69	1	4.26	1	4.21	3	4.41	1	4.00	1	4.40	1	4.19	1
Framing and Rough Construction	3.21	5	4.14	2	2.25	2	3.82	3	3.83	2	3.78	2.5	3.94	2
Characteristics of Home Construction	3.03	7	4.00	3	4.27	1	4.04	2	3.50	5	3.78	2.5	3.93	3
Preparation of the Building Site	3.45	3	3.62	4	3.80	4	3.66	4	3.50	5	3.56	4	3.61	4
Interior Design Concepts	3.18	6	3.58	5	3.52	5	3.63	5	3.67	3	2.88	7	3.51	5
Contracting and Subcontracting	3.52	2	3.20	6	3.34	7	3.52	6	3.50	5	3.44	5	3.33	6
Construction of Commercial Property	3.31	4	3.19	7	3.36	6	3.36	7	3.00	7.5	2.89	6	3.24	7
Road and Bridge Construction	2.61	8	2.65	8	2.50	8	2.91	8	3.00	7.5	2.67	8	2.68	8

Kendall's Coefficient of Concordance = .73 Average rank correlation = .67

Figure 10

TRANSPORTATION TOPICS

ITEM DESCRIPTION	Industry		Teachers		Principles		Educators		Curriculum Advisory Panel		Cadre		Total	
	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R
Automotive Systems	3.48	2	4.00	1	4.04	1	4.11	1	4.00	1.5	3.78	3	3.94	1
Mass Transportation Systems	3.38	3	3.23	3	3.21	3	4.05	2	4.00	1.5	4.11	1	3.49	2
Non-fuel Vehicles and Transportation Systems	2.90	4.5	3.25	2	3.43	2	3.84	3	3.50	5.5	3.78	3	3.42	3
Industrial Materials Handling	3.86	1	3.09	4	3.16	4	3.71	4	3.83	3	3.78	3	3.38	4
Aircraft	2.72	6	2.97	5	2.98	5	3.70	5	3.50	5.5	2.90	6	3.07	5
History and Natures of Transportation	2.90	4.5	2.68	7	3.88	6	3.57	6	3.50	5.5	3.44	5	3.02	6
Watercraft	2.38	7	2.77	6	2.75	7	3.50	7	3.50	5.5	2.89	7	2.89	7

Kendall's Coefficient of Concordance = .81 Average rank correlation = .77

Figures (11) and (12) present the means and ranks for six group ratings of the overall clusters.

The results of the importance ratings indicated that the Power and Energy cluster was considered the most important area of instruction to offer at the high school level. This cluster was closely followed by the manufacturing cluster. Transportation and construction were rated lowest in importance. There were differences among the groups of raters however. Industrial personnel rated manufacturing first and Power and Energy second, as did the teacher educators. It should be noted that only a 29% response rate was obtained from industry representatives as compared with 69% for teachers, 57% for principles and 57% of teacher educators. Total means were based on results of these four groups plus 6 ratings of the Curriculum Advisory Panel, 9 ratings of Cadre members and 26 ratings of teachers from special meetings held in Des Moines and Marshalltown. When examining ratings of individual topic areas within clusters, a similar order of clusters is obtained. In this analysis, Power and Energy topics are rated higher on the average by industry representatives and are consistent with all other groups. Manufacturing and Graphic Communications clusters are very closely ranked in both analyses but with manufacturing reversing its order with graphic communications in the second.

In examining the ratings of topics within the Power and Energy cluster the area of alternative energy was rated highest by the total sample followed by computer technology. Both of these areas had few textbook references available from the sample of 145 books reviewed. In view of the cluster rating, the topic ratings and textbook materials available, those two topics appear to be top candidates for development of instructional modules that would supplement high school industrial arts pro-

Figure 11

RELATIVE IMPORTANCE OF FIVE TECHNOLOGICAL CLUSTERS

DESCRIPTION	Industry		Teachers		Principles		Educators		Curriculum Advisory Panel		Cadre		Total	
	X	R	X	R	X	R	X	R	X	R	X	R	X	R
Power and Energy	13.69	2	15.36	1	15.02	1	15.35	2	16.83	1	16.75	1	15.08	1
Manufacturing	14.00	1	13.36	3	13.59	3	15.30	1	15.67	2.5	15.5	2	14.01	2
Graphic Communications	12.07	3	13.33	4	13.02	4	15.04	3	15.67	2.5	15.25	3	13.75	3
Construction	10.93	4	13.91	2	14.52	2	13.86	5	14.33	4	14.25	4	13.51	4
Transportation	10.31	5	12.90	5	11.57	5	13.87	4	14.00	5	13.50	5	12.90	5

Figure 13

RELATIVE IMPORTANCE OF FIVE TECHNOLOGICAL CLUSTERS AS DETERMINED BY RATINGS OF TOPICS WITHIN CLUSTERS

DESCRIPTION	Industry		Teachers		Principles		Educators		Curriculum Advisory Panel		Cadre		Total		Total Adjusted Scale Value	
	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R	$\bar{X}$	R
Power and Energy	3.78	1	3.82	1	3.60	1	4.10	1	4.05	1	4.00	1	3.84	1	14.84	1
Manufacturing	3.55	2	3.36	3	3.45	4	3.82	2	3.55	5	3.76	3	3.51	3	13.67	3
Graphic Communication	3.54	4	3.57	2	3.51	3	3.61	3	3.70	2	3.69	2	3.59	2	13.90	2
Construction	3.51	5	3.22	4	3.58	2	3.56	5	3.60	4	3.50	5	3.43	4	13.59	4
Transportation	3.00	5	3.14	5	3.19	5	3.72	4	3.60	5	3.52	4	3.30	5	13.01	5

groups. Industrial electronics was rated high by industry personnel but low by other groups. This discrepancy bears further examination by I.E. teachers. Was it rated low by teachers due to unfamiliarity with the area?

In the Graphic Communications cluster, the top four topics were Mechanical Drawing and Drafting; Computer Graphics, Design, Communications; Design Principles and Architectural Drawing and Drafting. Electronic design was ranked third among industry representatives. All topics except Radio and TV Productions had some reference material available to current textbooks. In terms of a need for supplementary instructional material, the topic of Radio and TV Productions should receive consideration. Information already existing for remaining topics might be better "packaged" for delivery in units of instruction designed for less total class time than implied by the text materials.

Manufacturing cluster topics were well represented in current textbooks with the exceptions of servicing, packaging, distribution and marketing. With the exception of servicing, these topics also received lower ratings than even topics. The development of materials for a module of instruction concerning product servicing would appear to be warranted. It should be noted that all topics except distribution and merchandising received ratings above 3.0. Lower ranking does not, therefore, indicate unimportance for instruction.

The construction cluster was rated higher by industrial arts teachers than the three other groups of raters. Within this cluster, there was greater emphasis placed on construction related to building of homes than commercial or civil projects. Nevertheless, commercial construction, estimating, interior design and road and bridge construction had little or no literature available to support these topics. This

preparation also had few references. It would appear justified to develop supplemental instruction modules in site preparation, interior design, contracting and construction of commercial property.

The transportation cluster was rated lowest by all groups except principals. Auto systems, mass transportation, non-fuel vehicles and industrial materials handling all received higher ratings than aircraft, trucking and watercraft. No literature on industrial materials handling and non-fuel vehicles were observed among the reviewed textbooks. These two areas, along with mass transportation systems, deserve attention for developing supplementary instructional material.

In summary, the following topics are recommended as priorities in developing instructional modules or supplement instruction to industrial arts:

Topic	Cluster
1. Alternative Energy	Power and Energy
2. Computer Technology	Power and Energy
3. Industrial Electronics	Power and Energy
4. Product Servicing	Manufacturing
5. Site preparation	Construction
6. Mass transportation	Transportation
7. Non-fuel vehicles and transportation	Transportation
8. Industrial materials handling	Transportation
9. Radio and TV Radio	Graphic Communications
10. Construction contracting	Construction
11. Construction of commercial property	Construction
12. Product packaging	Manufacturing
13. Product distribution	Manufacturing
14. Digital electronics	Power and Energy
15. Road and bridge construction	Construction

Objective 4. The development of goals, objectives and conceptual dimensions or framework of the high school industrial arts curriculum consistent with the "Idaho Guide for Curriculum Improvement in Industrial Arts, 9-12."

In development of goals and objectives for industrial arts, a number of considerations must be considered. Among those are:

1. Recognition that, as a general education subject, goals and objectives are decided on the basis of what learning is desirable for all students to achieve by the time they complete a high school diploma.
2. Recognition that large variance in course offerings exist as a function of school environment, school facilities and funds, teacher preparation, schedule time and flexibility, student interests and community interests and support.
3. Recognition that instructional approaches such as experimental, project, enterprise, lecture, self-directed, etc. are favored differently among both teachers and students and selection of methods other than those that are comfortable for teaching and learning styles may be counterproductive for learning.
4. Recognition that observational and measurement techniques are more limited for affective and psychomotor measurement and higher level cognitive learning.
5. Recognition that each group of students interests in a course that produces a unique learning environment different from that of another group in the same course.
6. Recognition that physical, emotional or intellectual handicaps or strengths may alter some objectives and goals either constric-

able or irrelevant for some individual students.

7. Recognition that philosophical differences regarding the potential overlap of science and vocational curricula may limit the implementation of goals from school to school.

In developing a set of goals and objectives, the staff of this project were guided by the above constraints plus the following guidelines:

a. Goals and objectives should reflect specific and measurable knowledge, skills and attitudes desired as outcomes of the curricula.

b. Goals and objectives should reflect, in as much as can be assessed, the needs of students following completion of their secondary education.

c. Goals and objectives should be ordered in their importance for (a) future learning achievement (prerequisite skills), (b) reinforcement of learning in related subjects (c) relevance to the broadest segment of the population.

d. Goals and objectives should establish achievement expectations that are appropriate to the mental and physical development level of the students addressed.

e. Goals and objectives should be attainable by as many methods of instruction as possible.

f. Goals and objectives should reflect learning beyond recall and recognition, that is, reflect learning at all levels of cognitive complexity.

g. Goals and objectives should not restrict learning by students due to their sex, race, or physical abilities.

The curriculum suggested by this project and reflected in the goals and objectives identified in this section are based on the following conclusions drawn from the surveys, literature reviews and analyses of this

study:

1. Current industrial arts is predominantly pre-vocational or vocational in content and coverage with emphasis on the T and I vocations.
2. Current industrial arts is predominantly concerned with male-dominated occupations in the semiskilled labor area.
3. Current industrial arts is predominantly concerned with the manufacturing industries utilizing metals, woods and plastics and much less with service industries (with the exception of auto mechanics), textiles industry, foods industry, agricultural industry, chemical industry, electronics industry, construction industry, mining industry, transportations industry, etc.
4. Current industrial arts emphasizes a narrow range of concepts and psychomotor skill development reflective of manual operations of increasingly less importance to industry as a whole and predominantly avocational in usage.
5. Current industrial arts does not typically include many important topics of industry such as personnel programs, research and development, production planning and control, packaging, marketing, warehousing, distribution, inventory, accounting, purchasing, etc.
6. Current industrial arts does not include many of the recent technology innovations, methods, materials and uses such as laser technology, ceramics technology, plastics and fiberglass materials, computer technology, automation, x-ray and sonic inspection methods, metal deposition methods, etc.
7. Current industrial arts content is oriented toward an increasingly smaller sector of the general population and work force (see Appendix F).

8. Current "clusters" utilized in industrial arts curriculum guidelines are inadequate to incompass the breadth of industries currently in existance, the diversity of labor and skills utilized in industry or the sequences of curricular materials required to achieve general education goals concerning industry and technology.

The above conclusions have led to the following recommendations which form the basis for the curriculum goals and objectives identified in this section:

a. Industrial arts curricula should reduce the emphasis on semi-skilled trades and crafts which represent predominantly production-line activities.

b. Industrial arts should be expended to include a balanced coverage of all major components of industry, that is,
   (a) the financial basis of industry
   (b) product ideation, development, research and prototyping
   (c) materials available to and used by industry
   (d) the acquisition, training, retention, allocation and relationships among personnel in industry
   (e) Production planning, controlling and operation
   (f) Product packaging, warehousing, marketing, and distribution
   (g) Industrial support services including accounting, inventory, document processing and retrieval, maintainance and management
   (h) Industry regulation including safety, wages, environmental impact, trade and investment.

c. Industrial arts curricula should expand to include
   (a) consumer skills in selection and use of industrial products

(b) technology advances in health, agricultural, education, business, energy production, communications, etc.

(c) impact of industry on federal and state legislation, environment, personal health and safety and education.

d. Industrial arts should articulate its instruction with science, business, mathematics, home economics, history and art curricula existing in the school programs.

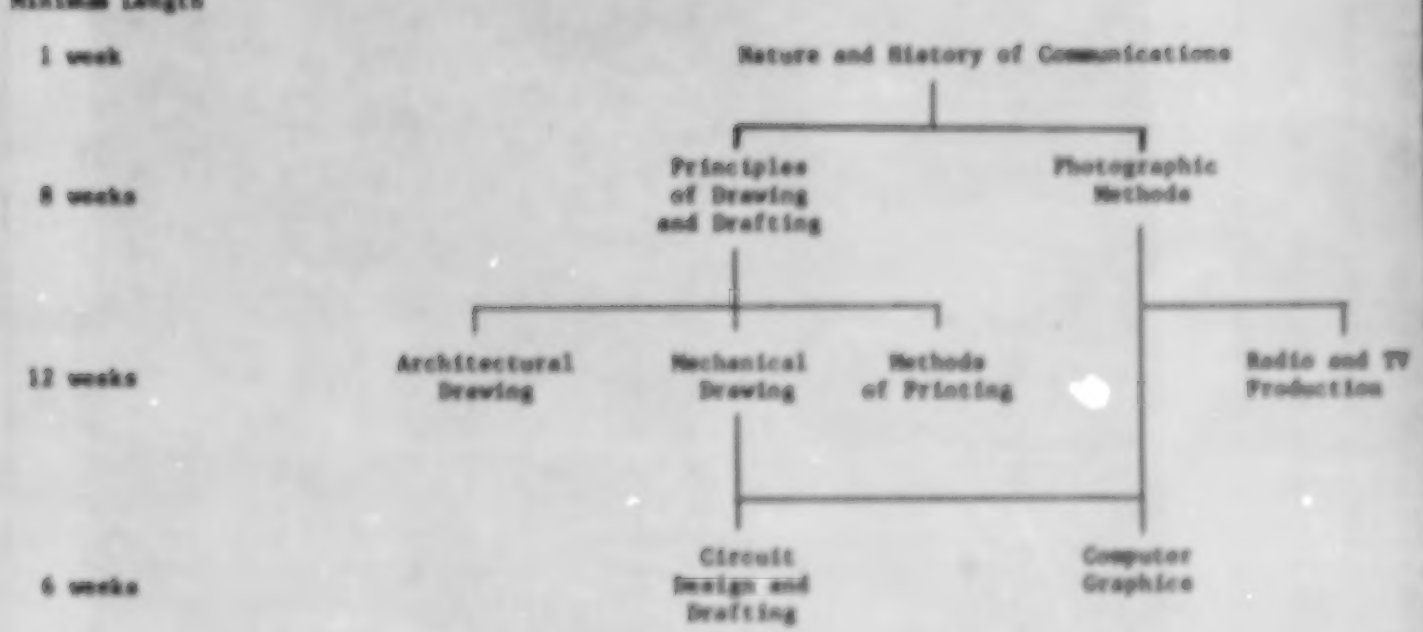
e. Industrial arts curricula should emphasize the understanding of the inter-relatedness of business, science, production, personnel, marketing and service aspects of industry.

f. Industrial arts curricula should reflect a developmental, hierarchical acquisition of knowledge and skills in an integrated sequence rather than the offering of unrelated, discontinuous topics.

g. Industrial arts should increase its role as a broad, exploratory curriculum and decrease its emphasis on job preparatory skill acquisition in a few, restructive vocational areas.

Reflecting the above recommendations, the following goals are suggested for the secondary level industrial arts program.

GRAPHIC COMMUNICATIONS



I. Graphic Communications Goals and Objectives

A. Nature and History of Graphic Communications

1. Students will understand the major changes which have occurred in printing, photography, design, and drawing.

2. Students will become familiar with the rate of technological change occuring in communications and its impact on society.

3. Students will better understand the relationship of graphic communications to art, science and other curricular areas.

4. Students will become familiar with the future roles of lasers, computers, holography, and construction technology with respect to communications.

Sample Objectives

A.1.a. Students will correctly list three major changes that have affected communications.

A.2.a. Students will plot a chart to show the speed of information processing over a period of 100 years.

A.3.a. Students will compile newsclippings of the use of graphic communications technology in art, science, home economics, math, english, and geography.

A.4.a. Students will investigate and report on the future roles of lasers, holography, computers or construction with respect to graphic communications.

B. Methods of Printing Goals

1. Students will understand basic printing methods including: relief, lithography, screen, spirit duplication, electrostatic, heat, infra red, diazo, and laser.

2. Students will understand appropriate printing methods for differing applications in commercial and industrial use.

Sample Objectives

B.1.a. Students will produce, generate and reproduce materials using any three of the following printing methods: relief, screen, lithographic, spirit duplication, electrostatic, diazo.

B.2.a. Students will choose appropriate printing methods for ten different jobs and describe the advantages and possible disadvantages of their choice.

c. Photographic Methods Goals

1. Students will understand the physical and mechanical properties of lens systems.

2. Students will be familiar with the basic concepts involved with cameras, film, photodetectors, and enlargers.

3. Students will understand the techniques needed for photo composition, photo processing and reproduction.

4. Students will understand the applications of video recording, and other forms of electronic storage and retrieval systems.

5. Students will become familiar with the uses of x-ray and high energy particle methods for material inspection and product testing.

Sample Objectives

C.1.a. Students will demonstrate their ability to understand the properties of lens systems by successfully assembling a mock-up of a single lens reflex camera.

C.2.a. Students will take a photograph, develop a negative, and make two prints.

C.3.a. Students will evaluate 10 slides and describe the techniques used for good photocomposition.

C.4.a. Students will use a computer to make a search for a microfilm.

C.5.a. Students will compare x-ray prints to detect welding defects.

D. Radio and Television Production Unit

1. Students will understand the concepts involved in advertising.

2. Students will be familiar with script production, scheduling, filming and recording, and broadcasting in the radio and TV industry.

Sample Objectives

D.1.a. Students will evaluate three radio or TV advertisements and rank their effectiveness, given five criteria.

D.2.a. Students will produce a 30 second advertisement including: script production, scheduling, filming and/or recording.

E. Design Principles Unit

1. Students will understand the concepts of form and aesthetic appeal.

2. Students will be familiar with material composition, assembly complexity, marketing requirements, performance, maintenance requirements, tooling costs, and packaging requirements.

Sample Objective

E.1.a. Students will analyze four products to determine to what degree these products possess aesthetic appeal.

E.2.a. Students will design and test a package that must be environmental and shockproof.

9. Mechanical Drawing and Drafting Units

1. Students will be familiar with the drafting equipment.
2. Students will be exposed to representative drawings and practices used in industry.
3. Students will develop competencies in lettering, scaling, dimensioning, projection, rotation, explosions, and pattern development.

Sample Objectives

9.1.a. Students will demonstrate their knowledge of drafting equipment by using correct terminology and proper use of equipment.

9.2.a. Students will complete successfully a minimum of plates representative of a broad variety of industrial drawings.

9.3.a. Students will accurately dimension an orthographic projection.

A. Architectural Drawing and Drafting Units

1. Students will understand the structural, cost, environmental, aesthetic and legal factors involved in architecture.
2. Students will develop competencies in designing, drawing and making models.

Sample Objectives

A.1.a. Students will develop a set of guidelines or building codes that they would like to see governing architecture in their town or state.

A.2.a. Students will design, draw and build a model of a play-ground structure.

B. Circuit Design and Drafting Units

1. Students will understand the production techniques involved in the design of electrical and electronic circuits.

Sample Objectives

0.1.a. Students will produce a circuit board using a photoresist etch/exposure and etch method.

1. Computer Graphics Basic

1. Students will understand the principles of computer aided design, design storage, design retrieval and use of automated manufacturing.

2. Students will develop competencies in developing images on a CRT and an output devices using microcomputers.

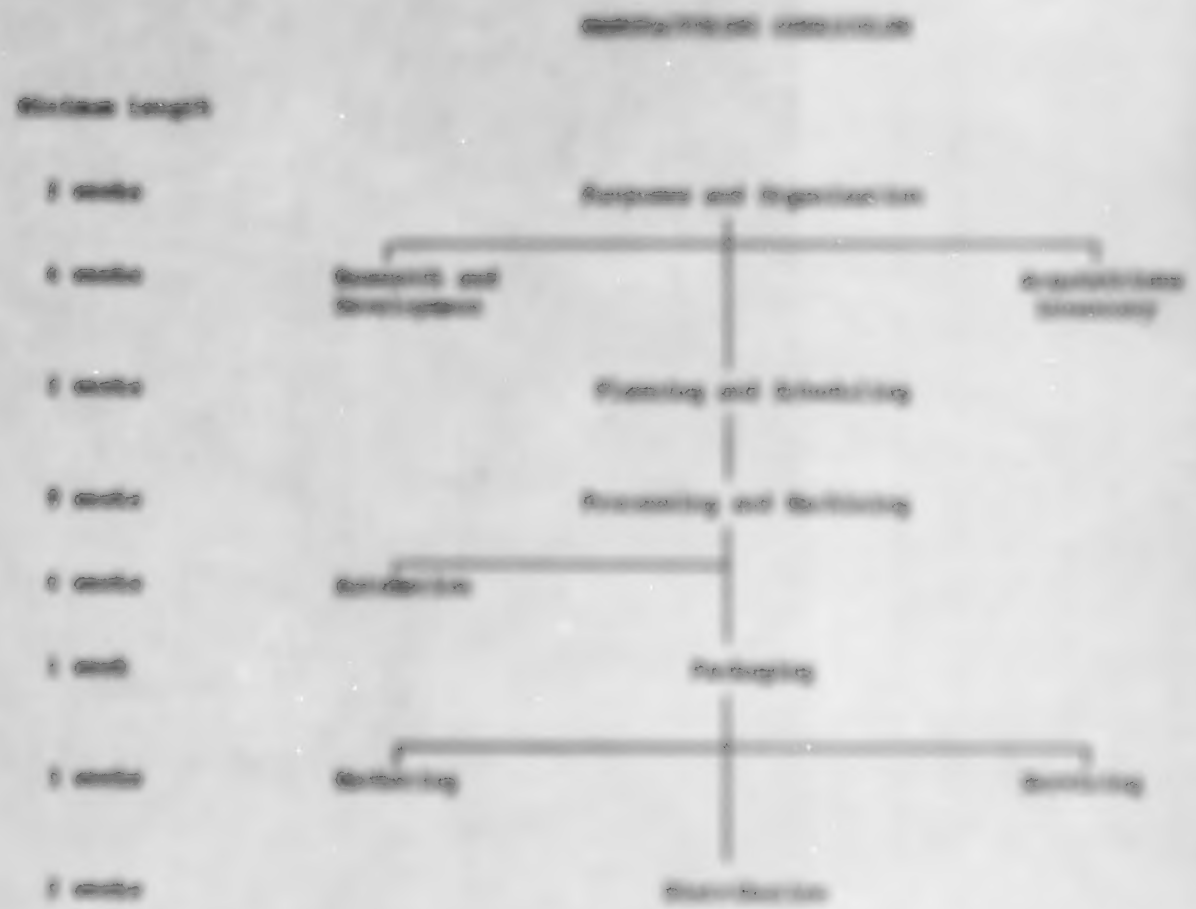
3. Students will be familiar with computer applications of geometry, trigonometry and drafting principles.

Sample Objectives

1.1.a. Students will design, store and retrieve a logo on a microcomputer.

1.1.a. Students will use a 3-D graphics package to draw an object.

1.1.a. Students will design and produce a parabolic curve for solar applications on the microcomputer.



III. [redacted]

A. Purposes and Organizational Goals

1. The student will understand the goals of American industry and how people are organized to accomplish them.

2. The student will understand the relationship between capital, labor, manufacturing, marketing and how work has been changed by modern industry.

3. The student will understand how consumers, owners, and managers personnel work together to accomplish the goals of the company.

4. The student will understand the role and marketing activities for company personnel at various organizational levels.

5. The student will understand the role of government regulations in industry and how they affect management decisions in financial, labor, and marketing matters.

Sample objectives

A.1.a. Students will correctly identify the management duties defined by Frederick W. Taylor.

A.1.b. Students will identify and explain the principles of management responsibility and authority.

A.1.c. Students will identify the management strengths and weaknesses of line and staff organizational structures.

A.1.d. Students will list the reasons why span of control varies from company to company and from department to department within a company.

A.1.e. Each student will make an organizational chart for the

[illegible] [illegible] [illegible] [

5. Students will understand how the unit price of manufactured goods is determined.

Basic Objectives

5.1.a. Given daily product demand, students will be able to calculate the forecasted demand, forecast error, and the moving average demand.

5.1.b. Given a PERT chart students will be able to calculate the critical path, early start, late start, and slack time.

5.1.c. Students will be able to calculate standard time, cycle time, work efficiency, and daily output.

5.1.d. Students will be able to develop a left-and-right hand chart for a screw-together type ball point pen and decide the workbench that might be used for production assembly of the pen.

5.1.e. Students will make standard process sheets, route sheets, load sheets, and job tickets for a mass production project.

5.1.f. Students will calculate direct material costs, direct labor costs, prime costs, overhead, and total costs for an actual mass production project.

5.1.g. Given the fixed cost, variable cost and the price per unit, students will be able to calculate the break even point.

6. Acquisition of Purchasing Skills

1. Students will understand why inventories are accounted at certain levels and that costs are kept at appropriate levels.

2. Students will understand the economics and responsibilities of purchasing and receiving departments.

Basic Objectives

6.1.a. Given the demand during lead time, safety stock, average

demand during time period, and average lead time the student will be able to calculate the reorder point.

D.1.b. Students will be able to explain the use of the two bin system and how it is used by companies and retail establishments to maintain sufficient product to meet customer demand.

D.1.c. Students will be able to cite five household products that have reorder points indicated on the container.

D.1.d. Given annual demand, set up cost, and carrying cost the student will be able to calculate the economic manufacturing quantity, and the economic order quantity.

E. Materials Processing and Making Goals

1. Students will understand the methods that companies use for the selection and organization of production equipment.

2. Students will understand the use and application of job lot, repetitive, and project production and how inventory planning is affected by the type of production that the company conducts.

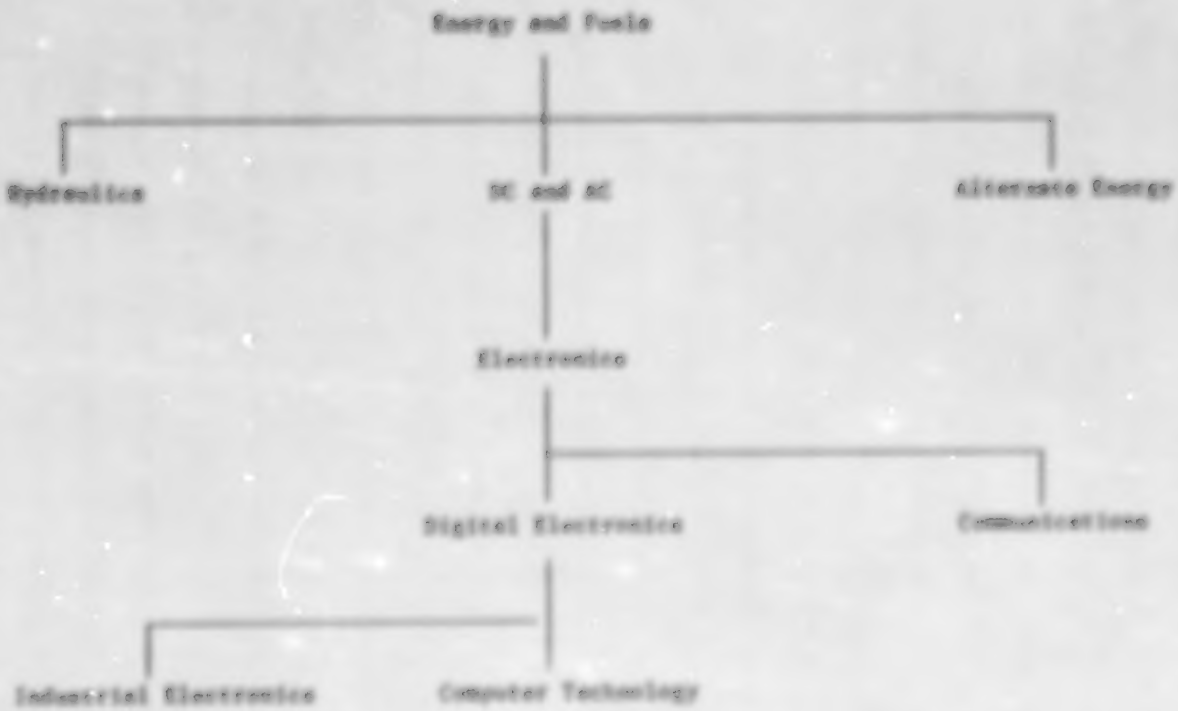
Sample Objectives

E.1.a. Given the initial cost, annual operation cost, expected years of service, salvage value, and the minimum rate of return the student will be able to select the most appropriate of several machine purchase options.

E.1.b. Students will be able to explain how block layouts, template layouts, and model layouts are used to organize a production line.

Minimum Length

Power and Energy Curriculum



III. Power and Energy Goals and Objectives

A. Alternating and Direct Current Goals

1. Students will understand the basic concepts of electrical energy, safety in use of electricity, and major electrical components terminology and use.

2. Students will understand the usage of electricity in industry including amount, costs, safety, applications to manufacturing, and management aspects.

3. Students will become familiar with career opportunities available in the electronics industry.

4. Students will understand the social dependency on electricity, its sources and impact on energy resources, future sources of electricity, costs of production and growth in usage of electricity.

5. Students will understand uses of electricity for heating, producing mechanical motion, lighting, communications and control applications.

Sample Objectives

A.1.a. Students will correctly define the terms joule, amperage, voltage, resistance, capacitance, resistance, and impedance at an 80% correct level using multiple choice or matching items.

A.2.a. Students will be able to correctly arrange the sources of electrical energy according to cost per kilowatt hour for hydroelectric, coal and oil fired turbines, atomic fired turbines, photovoltaic, and wind generators (including facilities costs, production costs, maintenance costs, etc).

A.T.E. Students will be able to describe the academic, importance and job responsibilities of at least 1 career in electricity/electronics at the skilled, technologist and professional levels.

A.A.E. Students will be able to identify and interrelate the financial, environmental, academic, governmental, legal and personal factors affected by costs and availability of electrical power.

A.T.E. Students will be able to demonstrate, by correct assembly of working models, the use of electricity for heating, lighting, mechanical force, control and communications.

B. Home Wiring Tasks

1. Students will understand transformer operations, fuses, single and multiple phase circuits, breakers, wire color codes, ground faults, voltages, grounds, etc. utilized in home electrical systems.

2. Students will be able to diagnose safety and operational problems with appliances and electrical service in a home setting.

3. Students will be able to read and interpret wire markers and estimate electrical consumption of home appliances.

4. Students will be able to replace appliance plugs, install new appliance cords, replace switches and outlet boxes and reset breakers or replace fuses.

5. Students will be able to evaluate home appliances for initial and long term costs of operation, repair and replacement.

Sample Objectives

9.1.a. Students will demonstrate knowledge of a step-up transformer by correctly connecting a transformer with 20 loops of a primary coil to produce a 100 volt output when given a 5 volt AC input.

9.1.b. Students will be able to calculate the total current demand in amps for a 1170 W lamp with appliances drawing 150, 200, 150, and 300 watts respectively.

9.1.c. Given work sheet dial readings on 3 meters interwired, students will be able to correctly calculate the kilowatt usage and costs.

9.1.d. Students will correctly identify single pole, single throw; single pole, double throw; double pole, double throw switches and produce wiring diagrams which demonstrate their appropriate use in home applications.

9.1.e. Given 3 models of home airconditioners that vary in price, efficiency, down time between failure and warranty periods, students will be able to select the one appliance which yields the lowest total costs over a 10 year period.

f. Electronics Basic

1. Students will be able to identify and describe the use of resistors, capacitors, inductors, filters, regulators, transistors, rectifiers, diodes and other electronic components.

2. Students will be able to draw elementary circuit diagrams for power supplies and amplifiers.

3. Students will be able to describe the characteristics of different electric meters available for AC and DC cur-

[illegible] such devices, e.g. display units, electronic meters, detection units, etc.

6. Students will understand phase angles for alternating voltage and current and the application to signal processing.

5. Students will demonstrate ability to construct printed circuit boards.

6. Students will be able to use multimeters, power supplies, oscilloscopes, testers and other electronics test equipment.

7. Students will understand the major divisions of the electronics industry, career specializations, manufacturing processes and procedures and market characteristics of the electronics industry.

Sample Objectives

E.I.a. Students will correctly identify the value of 20 resistors by color codes and measurement with a meter at a 90% accuracy rate.

E.I.a. Given a 50 series circuit with a 100 volt supply and 5 resistors of known value, students will be able to determine the voltage drop across each resistor.

E.I.a. Given a small 50 meter long carbon brushes, students will be able to replace worn brushes.

E.I.a. Given common meters, common collectors and emitter-base PNP transistor circuits, the student will correctly identify current/voltage phase angles of each.

E.I.a. Given a printed circuit board with a 5 volt regulator mounted on the board, students will correctly identify

the polarity of the ground bus.

S.E.A. Given a square wave generator driving a series of digital gates, students will be able to trace the input signals to offset input oscilloscope and determine the type of gate used.

S.T.A. Students will be able to describe the growth in communications, digital computing and industrial control systems through investigation of events beginning prior 1850 and continuing over 50 years.

B. Communications Basics

1. Students will develop an awareness of the communications industry vocabulary including telephones, microwave, AM and FM radio, TV, satellites, facsimile, and computer.

2. Students will demonstrate communications concepts of signal propagation, signal modulation, signal multiplexing and demultiplexing. Bit rates and regulations, frequency and wave length relationships, baud, speed, noise immunity, atmospheric characteristics and considerations, noise control (radio interference) and other communications concepts.

3. Students will demonstrate the career requirements and characteristics for occupations in the communications industry.

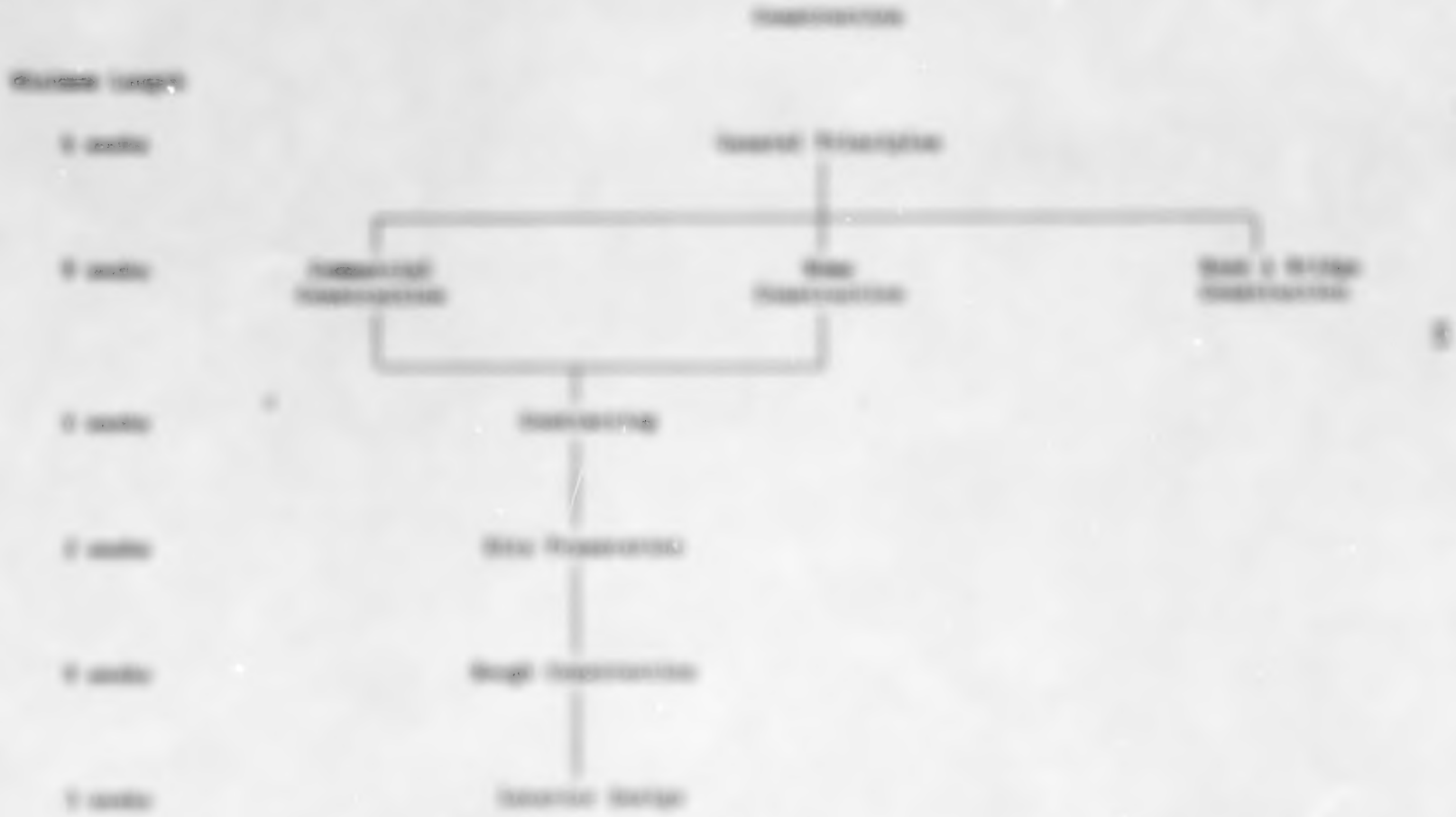
Sample Objectives

S.I.A. Given a mechanical alternating signal display on an oscilloscope, students will be able to determine whether the signal is frequency or amplitude modulated.

S.I.A. Given the carrier frequency to be broadcast, students will

be able to calculate the heat and chemical energies required for combustion.

B.3.e. Students will be able to describe the input and output qualifications of a chemical reaction.



[illegible]

[illegible]

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

8.1.a. Students will be able to identify the educational requirements for at least one of the building trade occupations.

B. Area Demonstration Skills

1. Students will understand load planning, determine equipment, moving requirements, and building problems.

2. Students will understand the methods and operations used in the foundations construction, framing, exterior construction, and finishing of a residential structure.

Generic Objectives

8.2.a. Given a set of blueprints and the current prices of building materials, students will be able to accurately estimate the cost of the foundation, framing, and finishing operations needed to construct the house.

8.2.b. Students will be able to identify the considerations used to determine the load propagation for a fabric building.

8.2.c. Given a set of blueprints students will be able to determine the amount and kinds of materials needed to construct the house.

8.2.d. Students will be able to perform environmental problems, and solve heat correctly to meet heat requirements.

8.2.e. Students will be able to keep a short and neatly the time sheet.

C. Commercial Construction Skills

1. Students will understand the commercial environment in regard to zoning codes, and financial considerations.

2. Students will understand that financing is provided in an area construction of a commercial building.

3. Students will understand the planning sequence used for con-

[illegible]

[illegible]

[illegible]

depreciation methodics used by companies and explain their advantages and disadvantages.

0.1.d. Students will be able to develop a PERT chart for constructing a single car garage.

6. Preparation of Building Site Units

1. Students will have an understanding of soil types, drainage, topography, utility locations, and other site related topics.

2. Students will understand the methods and equipment used for building site preparation.

Sample Objectives

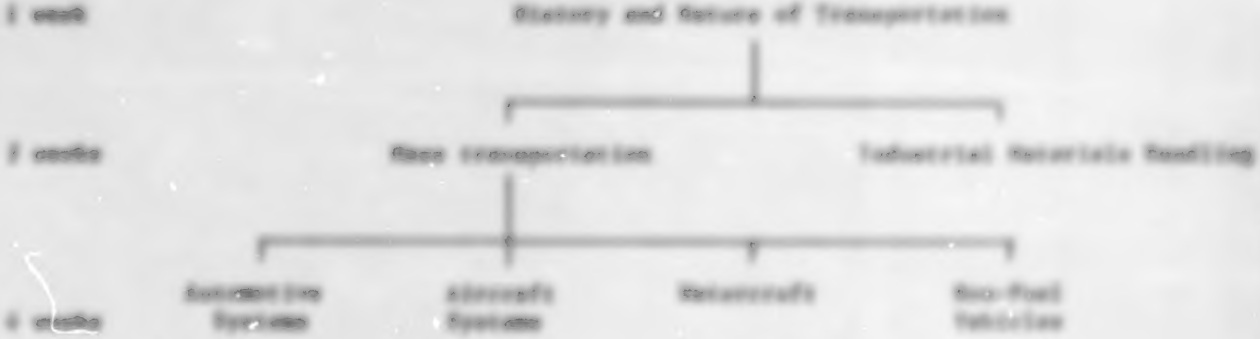
0.1.e. Students will be able to list the safety precautions that a contractor must take to protect workers from cave-ins when employees are working below grade.

0.1.f. Students will be able to cite possible causes of wet basements and recommend possible actions that can be taken to eliminate the problem.

0.1.g. Students will be able to explain how a combination of concrete soil types and dry weather can cause foundation damage.

Timeline Length

Transportation Curriculum



Sum of all modules = 19 weeks minimum

V. Transportation Curriculum Goals and Objectives

A. History and Nature of Transportation Goals

1. Students will understand the role of transportation in the distribution of manufactured goods and services.

2. Students will understand the effect of real and real conversion on industry placement, costs of products, costs of energy, laws and tax assessments.

3. Students will understand the costs, both financial and social, of alternative transport systems for raw and finished materials, personnel and fuels.

4. Students will understand the nature of occupations related to transportation and career opportunities in transportation.

B. Mass Transportation Goals

1. Students will understand the scheduling procedures used by commercial airlines, buses, trucking firms and railroads.

2. Students will understand the relationships among speed of transportation, gross weight, energy costs, personnel costs and accessibility of alternative systems.

3. Students will understand new systems being considered as alternatives including monorails, electric cars, hydroplanes, pipelines, etc.

4. Students will understand the impact of fuel shortages on mass transportation systems.

5. Students will understand shipping and licensing regulations for commercial transporters.

C. Industrial Materials Handling Goals

1. Students will understand principles of gas, liquid and solid materials transport mechanisms including the auger, conveyor, pneumatics, elevator, and pipe lines.
2. Students will experiment with models that demonstrate mechanical, electrical and control mechanisms used in energy conservation.
3. Students will understand the needs, maintenance requirements, functions, uses and problems of alternative heating systems.
4. Students will examine the relationship of automation and robotics to material handling systems including automatic storage and retrieval systems for parts inventory, warehousing, filling orders and product assembly.

F. Automotive Systems Units

1. Students will understand the principles of operation of alternative engines including 2 and 4 cycle internal combustion, gasoline, stirling, steam, electric, etc.
2. Students will understand the principles of power trains including manual and automatic transmissions; shaft, chain and belt drives; and differentials.
3. Students will understand the relationships among speed, weight, wind, road surface, tire maintenance and frontal area with fuel consumption.
4. Students will understand the maintenance requirements and routine diagnosis of auto systems.
5. Students will understand auto safety laws, regulations and design features related to the auto.

A. Aircraft Systems Tasks

1. Students will understand principles of basic aircraft systems including airfoil design, aerodynamics, control surfaces and flight control.
2. Students will understand tactical and maintenance tasks and tasks of operation for different types of aircraft.
3. Students will understand the laws, regulations and agencies which govern commercial and private construction and use of aircraft.
4. Students will experiment with alternative designs and systems for aircraft.

B. Aerospace Systems Tasks

1. Students will learn the laws and regulations governing testing and operation of private and commercial aerospace.
2. Students will understand the construction principles for aerospace with different purposes, power systems, capacities, speed, etc.
3. Students will gain experience in experimenting with alternate names, team, and skin designs utilizing models and simulated conditions.

C. Non-Fuel Vehicles Tasks

1. Students will understand use of non-fuel vehicles including gliders, bicycles, sleds, sailboats, pedal boats, submarines, pedal cars, etc.
2. Students will understand the relationships among weight, air drag, ground-to-vehicle surface area, and speed of alternative vehicles.

5. Students will understand the laws and regulations concerning construction and operation of gas-fuel vehicles.
6. Students will be provided an opportunity to design and construct alternative gas-fuel vehicles such as paper lovers, model cars, wind cars, etc.

Objective 5. Criteria for Curriculum Modification

In making decisions or modify existing curricula in a school program, a number of factors might be considered. Changes in specific curricular area programs are affected by:

a. the perceived need for change by the teachers, students, school administration, community and the profession;

b. the opportunity for change including flexibility for change cross schedules, resources available for use (materials, equipment and classrooms), time for planning and reviewing where needed, and acceptance of change by other audiences (parents, students, administration, etc.);

c. the importance of the proposed changes such as expected effects on other subject areas, adaptability to students with varying abilities, usefulness and knowledge, the relevance or relationship of the content to present and future behavior of students and the difficulty of the material to be learned;

d. the rewards for making changes such as social and economic recognition of successful, increased knowledge gain of students, cost and professional completion and acceptance and reduction in dissatisfaction or stress.

Assuming the above conditions are, or would be, satisfied, there are a number of specific criteria which might be applied to determine the desirability or acceptability of proposed curricular changes. These changes may be loosely categorized by the level of curricular structure affected, that is:

Level 1 - Changes in total curricular goals, courses offered or deletion goals, content of courses offered and methods for presenting that content.

Level IV - Changes in courses offered in terms of content and approaches.

Level III - Changes in course content of existing courses including deletion of some concepts and principles and the addition of new material. Instructional methods may change in response to the new content.

Level II - Changes in methods of instruction such as greater use of individualized learning materials, independent learning, group activities, etc.

The criteria adopted for evaluating proposed curriculum changes are arranged below in the level of changes described above. Because of the similarities and interrelated nature of these levels, the criteria for the lowest level are presented first, criteria for the next lowest level presented second, etc.

5. Criteria for Design of Instructional Methods

Methods of instruction include instructional procedures, group and individual instruction, use of audiovisual equipment, projects, organization of course topics, student directed experimentation, field trips, lectures, and demonstrations, guest speakers, etc. Criteria which may be used to evaluate the appropriateness of various instructional aids:

a. Is the method effective in that it produces the desired student changes in less time than alternative methods?

b. Is the method adaptable to variations in student abilities and physical limitations, student and and different classroom facilities?

c. Is the method desirable to instructor using it and your users or work samples?

d. Is the method cost-effective, that is, reasonable in cost for the expected instructional benefits?

e. Is the method flexible in terms of variations in local available time for its use, transportation to use, and environment in which it is used?

f. Is the method satisfactory independent of instructor skills or knowledge, student abilities and curricular content?

IV. Criteria for Changes in Course Content

Courses are defined as sequences of content covered [illegible] for a defined purpose for a defined time period, usually one semester. Course content in specific grouped into discernable units or topics that accept varying lengths of instructional time, say 1 to 3 weeks. Curriculum planning for a course consists of selecting topics, sequencing these topics, allocating time to these topics, selecting or developing instruction techniques to assess achievement of students on these topics and developing appropriate instructional methods for the topics. Selecting course content units or topics is influenced area to difficult due to the large number of possible topics to include in any one course or course. Criteria which can be used to evaluate the appropriateness and adequacy of a topic and instruction material supporting that topic are:

1. Does the topic represent an area of information useful to a broad segment of the population?
2. Does the topic support the goals and objectives of the course?
3. Is the topic difficulty appropriate to the demonstrated and educational needs of the students for which it is the course?
4. Does the topic provide information which relates to [illegible] topics and/or provide information [illegible] to more advanced topics?
5. Are the materials available for the topic appropriate for the intended students, e.g. of acceptable reading difficulty levels, as related to student experiences in other courses and appropriate records of ability?

[illegible]

[illegible] [illegible]

[illegible] [illegible] [illegible] [

[illegible]

[illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

(i) [illegible]

(a) [illegible] [illegible] [illegible]

time unit, instructor's testing package, list of student activities, list of teacher demonstrations, recommended student projects, module resource requirements, demonstration slides and films and reference of resource materials.

b. Student self-instruction manual should include short paragraphs with self-test material imbedded in, or following each paragraph. Pictures, materials, products, and required student activities should be clearly indicated within paragraphs or margins.

c. Use of color, bold-type or other media methods should be used to identify and stress key concepts.

d. Pictures, text, references should clearly be sex-bias free and include equal reference to male and female participants.

e. Where appropriate and available, alternative activities and materials should be made available to students with visual, hearing or other physical limitations.

Objective 6. The Dissemination of Descriptions of Current Industrial Arts Programs.

One hundred industrial arts teachers were randomly selected from Iowa high schools and mailed a questionnaire. The questionnaire (Appendix D) was designed to identify course titles, unit titles, amount of instructional time devoted to various units, and other data descriptive of industrial arts courses taught in Iowa. A total of 28 teachers responded. Some teachers provided data for multiple subjects taught. Course outlines obtained were:

Production	20
Power and Energy	14
Graphic Communications	11

Based on responses received, most industrial arts in Iowa high schools could be classified in one of the 11 following courses:

A. Production	B. Power & Energy	C. Communications
1. woods	5. small engines	9. drafting
2. metals	6. automechanics	10. arch. drafting
3. welding	7. electricity	11. graphic arts
4. plastics	8. electronics	

Obviously, titles actually used varied greatly. For example, in the metals area we obtained:

Bench Metals
Metals Machining
Hot Metals
Basic Metals
General Metals
Metals 1, 2
General Shop Metals
Metalworking
Machine Metals
Machine Shop 1, 2

Similar diversity of titles were found in woods, automechanics, etc. Few of the respondents were able to provide a syllabus of their course or a breakdown of the course by units or topics covered. The results of this survey were disappointing from several viewpoints:

(1) the small percentage of responses (28%)
(2) the lack of anything but traditional courses identified
(3) the lack of course outlines for courses currently taught

The investigators must conclude that most industrial arts courses taught in Iowa are in traditional areas, e.g. metals, woods, drafting and automechanics, that most instructors have not conceptualized their course by major topic or unit divisions and few are concerned with reviewing or changing those courses. These findings would be consistent with the results obtained in Report 1 of the Illinois Industrial Education Information System (1981) summary table 1 on the following page.

TABLE 1 NUMBER OF MOST FREQUENTLY REPORTED IND. ARTS AND VOC. IND. COURSES AND SECTIONS FOR HIGH SCHOOLS AND AVC'S[a]

Courses	Grade 9-10[a]				Grade 9-12				Grade 11-12/AVC			
	Courses		Sections		Courses		Sections		Courses		Sections	
	N	%	N	%	N	%	N	%	N	%	N	%
Ind. Arts:												
Sr. Hi Gen. Shop	48	24.2	94	26.7	10	5.4	29	7.6				
Gen. Metals	23	11.6	38	10.8	15	8.2	35	9.1	9	3.2	15	3.4
Woods I	23	11.6	47	13.4	24	13.0	51	13.3	11	4.0	16	3.6
Drafting	18	9.1	32	9.1	35	19.0	71	18.5	9	3.2	16	3.6
Electricity	13	6.6	23	6.5	6	3.3	13	3.4				
Power Mechanics	10	5.1	20	5.7	2	1.1	8	2.1				
Graphic Arts	9	4.5	16	4.5	6	3.3	12	3.1				
Woods II	8	4.0	11	3.1	3	1.6	4	1.0				
Drafting II	1	0.5	1	0.3	5	2.7	6	1.6				
Auto Mechanics	4	2.0	7	2.0	13	7.1	41	10.7				
Voc. Ind.:												
Constr. & Bldg. Trades									22	7.9	46	10.4
Metalworking									18	6.5	28	6.3
Auto/Power/Diesel									16	5.8	35	7.9
Ind. Coop. Exper.									13	4.7	21	4.7
Drafting									11	4.0	19	4.3
Graphic Arts									11	4.0	15	3.4
Welding									10	3.6	23	5.2
TOTAL	157	79.3	289	82.1	119	64.7	270	70.5	130	46.8	234	52.6
Total Offerings	198	100.0	352	100.0	184	100.0	383	100.0	278	100.0	445	100.0

[a] Total reported courses at the high school level=660
Total reported sections of courses at the high school level=1180

Section VII RECOMMENDATIONS:

I. Concerning the Theoretical Basis of Industrial Arts/Technology Curriculum and Content

II. Concerning Re-examination of the State Guidelines

III. Concerning Broadening Curricular Content in View of Current Trends

IV. Concerning Allocation of Instructional Time to Current Industrial Arts Emphasis

V. Concerning a Sequence of Topical Instruction

VI. Concerning Minimum Content Offerings

VII. Concerning Development of New Instructional Materials

VIII. Concerning Assessment of Industrial/Technical Knowledge and Skills

IX. Concerning Avocational Skill Development

X. Concerning Establishing a Data Base of Teachers and Programs

XI. Concerning Discussion and Dissemination of this report

XII. Concerning Continuation of Phase I

I. Recommendation for the Further Articulation of the Theoretical Bases and Structure of Industrial Arts Curricula

A number of noteworthy efforts to establish a basis for content to be included in industrial arts have occurred over the past fifty years. Thousands of dollars have been spent on development and implementation of IACP, the Maryland Plan, Industriology, the Illinois Plan, etc. Recently curriculum leaders have met and produced what has become known as the Jackson's Mill Industrial Arts Curriculum Plan (9, 1981). This is an additional attempt to examine the nature of society, industry, technology and education and integrate the prior curriculum development efforts to produce a coherent, justified direction for development of the industrial arts curriculum. It is clear that a total K-12 program should be based on a well-defined body of knowledge, understanding of instructional methodology, clearly defined scope and justified allocation of instruction time. In view of the current diversity in topics, sequences, allocations of instructional time and facilities available for industrial arts in Iowa schools, it is imperative that a philosophy of Iowa Industrial Arts be developed and carefully communicated to public school personnel.

II. Recommendation to Re-examine the State Guidelines

The Iowa Guide for Curriculum Improvement, produced in 1975, emphasized three dominant systems of industrial technology; Communication, production, and energy and power. Courses at the senior high were "clustered" within these broad systems. The results of this report suggest five groups rather than three, i.e. Communications, Construction, Manufacturing, Power and Energy, and Transportation. The Jackson's Mill recommendations are the same with the exception of Power and Energy apparently subsumed as part of the "input" phase of manufacturing. It may be further argued that the Power and Energy cluster is itself rationally divisable into electronics and energy clusters. While the Iowa Guide provides an overall rationale for K-12 industrial arts, it lacks specificity in

(a) course titles
(b) course sequences
(c) course topical content
(d) course activities
(e) instructional methods

While broad generalities and definitions of what industry and technology are may be useful in constructing curricula, the reality is that few teachers possess the time, motivation and skills to translate these broad principles into course outlines and daily lesson plans. A guideline with greater specificity would be welcome. It is therefore recommended that the Cadre, in cooperation with the DPI embark on a major re-examination of the philosophical basis of the state Guide and develop a guide with greater specificity regarding industrial arts content to offer at the K-12 grade levels.

III. Recommendation to Broaden Curricular Content at the High School Level

As indicated elsewhere in this report, the courses of drafting, metals, woods and automechanics dominate the high school curriculum in I.A. Some schools offer printing, photography, construction, electricity, electronics, plastics and computer applications. A few offer courses in research and development and industrial enterprise.

It is recommended that content outlines be developed in the following areas for implementation at the high school level:

(a) Computer concepts and applications in industry
(b) Plastics, ceramics, fiberglass and non-metal materials of industry and technology
(c) Reprographics technology
(d) Electronics technology
(e) Industrial research and development
(f) Transportation technology
(g) Construction technology
(h) Automation and robotics technology
(i) Industrial organization and management

In implementing this recommendation, it is suggested that curriculum development workshops be conducted during the summer months in which high school teachers will develop these units of instruction.

IV. Recommended Allocation of Instruction Time to Traditional Industrial Arts Courses

The traditional courses of woods, metals, drafting and automechanics are taught in courses ranging from one to six semesters in different school systems. To be consistent with the philosophy of industrial arts as a general education subject, and to assist in securing additional instructional time that may be made available to introduce additional industrial and technological units of instruction, it is recommended that:

(a) a maximum of one semester of coursework be available for woodworking, drafting, automechanics and metals,
(b) students desiring additional coursework in the traditional subjects be encouraged to consider vocational courses in those areas, and
(c) that instructional time made available through reductions in the traditional areas be utilized to introduce other industrial arts units proposed in this report.

V. Recommended Sequencing of Instruction in Industrial Arts

Due to its breadth of content, industrial arts is prone to offer a variety of courses with little concern for prerequisites, subsequent courses or interaction among I.A. courses. Where an adequate middle school program exists to provide a foundation in materials, processes, drawing and drafting, electricity, etc., specialized courses at the high school may not pose a significant problem. However, transfers from district to district as well as large variations in middle school programs creates the situation in which few assumptions can be made of prior student learning. It is recommended that the Industrial Arts Cadre develop a set of minimum competencies and experiences each and every high school student should acquire prior to completion of a high school diploma in the state of Iowa. These competencies should not be specified in terms of courses but rather in terms of explicit industrial and technology concepts, skills and experiences. It is further recommended that these competencies be ordered, that is sequenced in order of student acquisition. It is believed that development of a list of sequenced competencies will contribute significantly in development of an industrial arts curriculum. Topics and units may then be developed which are responsive to those competencies. The sample goals and objectives identified for the five clusters recommended in this study are representative of sequenced units of instruction.

VI. Recommended Minimum Content Offerings for High School Industrial Arts.

Consistent with the five clusters identified in this report and the curriculum already developed for the middle school industrial arts, the following units of instruction (not necessarily courses) should be available in high school industrial arts:

1. Financial bases of industry and technology
2. Industrial research and development
3. Modern materials of industry and technology
4. Personnel management and relationships in industry
5. Production planning, control and operations
6. Product packaging, storage, marketing and distribution
7. Industry support services-accounting, inventory, sales, maintainance, data processing and management
8. Industrial regulations: Organizational, financial, safety, trade, environmental
9. Energy sources, costs, utilization and alternatives
10. Entrepreneur and small industry organization
11. Evaluation, purchase and use of new technology products
12. Computer technology in home and industry
13. Reprographics, photography, computer aided design
14. Mechanical, architectural and electronic drafting
15. Manufacturing tools, equipment and processes
16. Transportation and industrial materials handling
17. Electricity and electronics in home and industry
18. Construction planning, materials and processes

Figure 14 Decision Table for Course Prerequisites in a Structured Industrial Arts Curriculum

Course Taken ↓	Energy Systems	Graphic Communications	Manufacturing Processes	Transportation Systems	AC/DC Electricity	Auto Systems	Materials of Industry	Architectural Drawing	Digital Computers	Industrial Automation	Construction	Photography	Printing
Organization of Industry	X	X	X	X	X	X	X	X	X	X	X	X	X
Energy Systems			X	X	X	X	X		X	X			
Graphic Commun.			X				X	X		X	X	X	X
Manufacturing Process.							X			X			
Transportation Systems													
AC/DC Electricity									X	X			
Auto Systems													
Materials of Industry										X			
Architectural Drawing											X		
Digital-Computers										X			
Industrial Automation													
Construction													
Photography													X
Printing													

Course to Take →

VII. Recommendations Concerning Instructional Materials Development

Examination of the results of Objective 3 suggests fifteen topical areas for development of instructional material to supplement industrial arts courses arranged in five clusters. The topics listed were selected on the basis of ratings by teachers, teacher educators, principals and industrial personnel. The availability of instructional material as assessed through an examination of textbooks provided to the project by publishers was also utilized to identify topics for development. It is recommended that summer workshops be sponsored by the Department of Public Instruction, through cooperation with the Industrial Arts Cadre and the state universities, to develop instructional support materials for the topics identified. It is recommended that these materials be as "self-contained" as possible and include:

(1) pre-and post-test evaluation instruments,
(2) textual material and references to textual materials,
(3) overhead transparency material and references for film, videocassette, computer or other instruction media,
(4) lesson plans and suggested time allocations for teacher and student activities, and
(5) suggested activities and projects for student involvement in learning the material.

Use of self-directed learning packages (modules) is encouraged where feasible and appropriate.

VIII. Recommendation for Assessment of Industrial/Technical Knowledge at the High School Level

It is recommended that the Industrial Arts Cadre support activities leading to the development of a comprehensive test of industrial and technical knowledge and skills. This standardized instrument would be utilized to assess the quality of educational development in the industrial area of students within a given high school. Current tests such as the Iowa Tests of Educational Development do not include industrial arts concepts. In view of the long history of industrial arts education in our schools and the importance of this general education subject to the preparation of students for post-high school education, work and informed citizen decisions, it is surprising and unfortunate that education has ignored this important area of assessment. A part of the responsibility for this current status must rest with the profession of industrial arts itself - it has not actively pressed test makers and schools to identify strengths and weaknesses of students in this academic area.

IX. Recommendation to Encourage Avocational Skills Development as an Extra-Curricular Activity

The content of Industrial arts is so large that it is difficult to provide all the desirable education and skills activities within the confines of the crowded curricula of most school programs. A major alternative to use of formal classroom time is the expansion of after-school, sponsored activities. Currently, athletics are the main after-school activity pursued by a small number of students. A large number of students could potentially become involved in industrial arts activities provided after school or evenings. These activities could involve:

(a) Interscholastic competition in product development (projects), demonstrations of industrial techniques, inventions and innovative processing techniques
(b) Participation with industry for field trips, training programs, career exploration and education
(c) Joint student/parent activities in building projects
(d) Formal club activities

Because many students are interested in developing a higher degree of vocational-level skills than are possible to acquire or justified in terms of instruction time available during regular classwork, the extra-curricular activities should be encouraged. Because use of regular classrooms may impose additional expenses, and because teacher salaries for the activities may not be budgeted, several alternative funding methods can be explored. For example:

(1) Assessment of a fixed fee for instructor and space utilization
(2) Industry sponsorship
(3) Community agency funds, e.g. YMCA/YWCA, Community Chest, Churches, etc.
(4) Special school board appropriations
(5) Volunteer craftsmen and industrial personnel
(6) Sale of club or activity products
(7) Use of vacant buildings, community activity centers, local industries, etc. for facilities

X. Recommendation to Establish a Data Base of Industrial Arts Teachers and Programs

In construction of new curricula for industrial arts, it is imperative that there be statewide involvement, education and communication with industrial arts teachers throughout the state. To accomplish this requires up-to-date information on the teachers and industrial arts programs in the schools. Access to DPI files for this purpose is insufficient to meet the detailed information needs. Required is a system that:

(a) identifies each teacher of industrial arts and contains age, sex, course titles taught, grade levels taught, major area of expertise, degree level, certifications, school of last degree, cadre workshops completed, and professional memberships.
(b) identifies courses taught in industrial arts including titles, cluster classification, grade level of students enrolled, number of males and females enrolled, no. of handicapped students enrolled, minority enrollment, number of hours of instruction per semester and year, textbook used if any, and prerequisite courses required.
(c) identifies facilities available for industrial arts including number of square feet of laboratory space, type and number of machines available, number of student stations available, safety equipment available, major subject (cluster) usage and number of hours used per day.
(d) identifies clubs and extra-curricular activities offered in the area of industrial arts.

The data base could be microcomputer based which would permit copying of the complete base to several users on an inexpensive media. An initial data collection with annual update procedures would be required. Initial data could be established using the DPI data file.

XI. Recommendation for Dissemination of this Report

The findings and recommendations of this report should be disseminated, in condensed form, to industrial arts teachers. It is recommended that:

1. A media presentation using slides and cassette tape or videotape be produced which summarizes the major issues, findings and recommendation of the report.
2. A short two to four page leaflet be produced to summarize recommendations and announce discussion meetings.
3. Professional articles discussing the recommendations and findings be written and published in the Iowa Industrial Education Newsletter.
4. Statewide meetings be held during the 1982-83 school year to involve classroom teachers in discussion of the findings of this report, disseminate cadre materials, discuss the use of the National Standards project and other related industrial arts concerns.

XII. Recommendations Concerning Continuation of Phase I.

While the objectives of Phase I as specified in the original proposal have been met, there has not been an opportunity to obtain the reactions of industrial arts teachers, industrial arts educators, industrial personnel and other interested citizens to the results and recommendations of the study. Before new materials are developed and courses modified, it is appropriate to:

1. Assess the acceptability of new curricular emphasis addressed in this report.
2. Assess the ultimate costs for materials, facilities, in-service training and formal training requirements to school districts desiring to implement the recommendations.
3. Identify courses and extra-curricular as well as community agencies which might provide comparable instruction outside of Industrial Arts.
4. Develop appropriate media to describe the recommendations and stimulate discussion.
5. Determine the consistency with recommendations and activities of other state organizations and national professional organizations.

To accomplish the above, it is recommended that funds be obtained to coordinate:

(a) the holding of 5 regional conferences in the state of Iowa during the year 1983 to present and discuss the recommendations of this report and the philosophical basis for curricular changes. These meetings would be open to teachers, administrators, industrial personnel and interested citizens.

(b) a week-long meeting of industrial arts teacher educators, industrial personnel, industrial arts coordinators and public school administrators be held during the summer of 1984 to
   - review major industrial arts curriculum projects
   - establish and adopt a theoretical framework for Iowa Industrial Arts Education
   - translate the adopted theoretical framework into recommendations for industrial arts courses, course sequences, course content and instructional methodology appropriate to kindergarten through 12th grade education

participation in this conference would be by invitation and selection of the Iowa Industrial Arts Cadre. Special guests from outside of Iowa that are leaders in industrial arts curriculum development would be invited as keynote speakers and presentors

(c) development of visual materials and media to be made available to local school boards, school administrators and teachers which describe the current status, trends and needs for industrial arts education.

1. The Iowa Guide for Curriculum Improvement in Industrial Arts, K-12. A Study of Industrial Technology. Iowa Industrial Education Association, State Committee on Industrial Arts Teacher Education, Iowa State University, University of Northern Iowa and Iowa Department of Public Instruction, Des Moines, Iowa, 1975

2. A Proposal to Meet the Needs of Students and Society Through Industrial Education. Benson, James M., 63 RD Mississippi Valley Industrial Education Conference. St. Louis, Missouri, Nov. 1976.

3. Construction Education Curriculum Project. Lux, Donald G. and Roy, Willis E. Associated General Contractors of America Education and Research Foundation. Ohio State University, 1974.

4. Standards for Industrial Arts Programs. Dugger, William E. Jr., Director, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1981.

5. Rationale for Developing Standards and Guidelines for Graduate Degree Program Evaluation in Industrial Arts Teacher Education. American Council on Industrial Arts Teacher Education, William D. Umstattd, Chairman. Ohio State University, Columbus, Ohio, 1979.

6. "Manufacturing Education Curriculum Project. A Rationale and Structure for Manufactu.ing Education in the Senior High School." The Manufacturing Education Curriculum Project. Lux, Donald G. and Roy, Willis E. Codirectors. Ohio State University, Columbus, 1975.

7. Peterson, Richard E. Discovering Technology in the Elementary School Classroom", Man, Society and Technology, Dec. 1980.

8. Israel, Everett N. "Stagnation in Industrial Arts, Part 2," Man, Society and Technology, Feb., 1981.

9. Jackson's Mill Industrial Arts Curriculum Theory, Edited by James A. Hales. American Council of Industrial Arts Supervisors, 1981.

Appendix A

STATE GUIDELINES FOR INDUSTRIAL ARTS

Course and Topic

Recommendations

State: Connecticut

Level: K - 12 (general outlines)

Course: GRAPHIC ARTS

History of Graphic Arts
- History
- Scope of Graphic Arts Industry Today

Design & Layout
- Tools & Materials
- Layout Principles
- Planned Layouts
- Typography
- Visual Presentation

Image Generation and Conversion
- Composition
- Continuous Tone Photography
- Process Camera
- Contact Copies
- Diffusion Transfer Process
- Standard Proofreaders Marks
- Expose and Develop Processes
- Color Separations
- Scribe Film

Image Carriers
- Relief Image Carriers
- Lithographic Image Carriers
- Gravure-Intaglio Image Carriers
- Screen Process Image Carriers

Preproduction
- Film Assembly
- Relief Imposition
- Paper and Paper Measurement
- Ink

Production
- Safety
- Chemistry of Offset Lithography
- Lubricants
- Feed Systems
- Register System
- Dampening Systems
- Inking Systems
- Printing Systems
- Delivery Systems
- Web Presses Letterpress
- Letterpress
- Planographic
- Printing System
- Delivery System
- Web Presses
- Letterpress
- Feeder Pile Adjustments
- Porous

Organization and Management
Coping and Duplicating
Binding, Finishing & Packaging
Careers in Graphic Arts

Course: WOODWORKING (9 - 10)
(Students expected outcomes not the course content oulines)

Course: DRAFTING (K - 12)

Tools Equipment and Materials - Industrial Drawing
Sketching
Lettering
Spatial Relations
Tools
Data Presentation
Sections
Pictorials
Auxiliaries
Revolutions
Developments
Intersections
Applied Mechanics or Vector Geometry
Dimensioning Systems
Application of Tracing Media
Copiers
Reproductions
Model Making
Design
Advanced Dimensioning
General Tolerancing
Symbology Depiction
Datum Referencing Utilization
Tolerances of Location
Tolerances of Form and Runout
Dual Dimensioning
Dimensioning for Numerical Control
Formula for Positional Tolerancing
Form Proportion, and Comparison of Symbols
Industrial Drafting
Threaded Fasteners, External and Internal
Fasteners Extended
Electronics Depiction
Welding
Wood - Furniture/Cabinetry
Technical Illustration
Problem Solving
Pipe Drawing
Cams
Mechanical Power Transmission

Architectural Drawing

History of Architecture
Careers in Architecture
Consumer Protection/legal and Financial Implications
Architectural Planning Function
Architectural Drawing Function

State: Hawaii

Level: Not Specified

Course: MANUFACTURING TECHNOLOGY

- Manufacturing Management Technology
  - Planning
  - Controlling
  - Organizing
- Manufacturing Production Technology
  - Pre-Processing
  - Processing
  - Post-Processing
- Manufacturing Personnel Technology
  - Hiring
  - Training
  - Working
  - Reclassifying
  - Organizing

Course: CONSTRUCTION TECHNOLOGY

- Construction Management - Technology
  - Planning
  - Organizing
  - Controlling
- Construction Production Technology
  - Pre-Processing
  - Processing
  - Post-Processing
- Construction Personnel Technology
  - Hiring
  - Training
  - Working
  - Advancing
  - Retiring

Course: GRAPHIC ARTS TECHNOLOGY

- Pre-Processing
  - Copy Preparation
    - Drawing
    - Paste-Up
    - Designing
    - Layout
    - Photography
- Processing
  - Image Preparation
  - Image Transfer
- Post-Processing
  - Bindery

Course: ELECTRICITY/ELECTRONICS TECHNOLOGY

- Electrical Phenomena
  - Structuring
    - Atomic Theory
    - Electron Theory
    - Magnetism

- Natural
- Artificial
- Transforming Energy
  - Production
  - Effects
- Analyzing
  - Formulation
  - Instrumentation

Electricity
- Producing
  - Chemical Sources
  - Mechnical Sources
- Distributing
  - Transmission Devices
  - Protection Devices
- Utilizing

Electronics
- Controlling
- Altering Waveforms
- Oscillating
- Amplifying
- Switching

Course: DESIGN/DRAFTING TECHNOLOGY

Pre-Drafting
- Identifying Problems
- Formulating Preliminary Ideas
- Analyzing
- Refining and Finalizing
- Planning the Drawing

Drafting
- Describing Shapes
- Describing Sizes
- Describing Relationships
- Describing Characteristics

Post-Drafting
- Checking
- Revising
- Reproducing
- Filing and Cataloging
- Displaying

Course: POWER TECHNOLOGY

Source
- Solar
- Extro Solar

Conversion (Mechnical)
- Thermo
- Fluid
- Electrical

Utilization
- Transportation
- Communication
- Production

State: Indiana

Level: not specified

Course: INDUSTRIAL COMMUNICATIONS

Orientation to Industrial Communications
- Industrial Communication Structure
- Industrial Communication Areas
- Social Impact of Industrial Communication (examples of communication common to various members of the industrial environment)

Industrial Communication Processes
- Message Generation
- Message Reproduction/Storage
- Message Distribution

Career Opportunities in Industrial Communications
- Message Generation
- Message Reproduction/Storage
- Message Distribution

Course: AEROSPACE

Grade 9:
Introduction to Aerospace
Social, Political, Economic, Educational and Cultural Impacts of Aerospace
Earth Science in Aerospace
Career Orientation
Aerospace Vocabulary

Grade 10:
Rocket and Missile Fundamentals
Basic Aerodynamics and Preflight Facts
Introduction to Meteorology (correlated with Basic Aerodynamics)
Physiology of Flight and Space Travel
Aerospace and Ecology
Introduction to Communication and Control Systems
Aerospace Age Careers - Guidance and Counseling
Vocabulary

Grade 11:
Review of Aerodynamics and Preflight Facts
Power Plants - Instruments - Systems
Practical Aeronautical Meteorology for the Airman
Flight Computer Functions
Basic Navigation
Radio Navigation
Air Traffic Control - Commnications - FAA Regulations
Introduction to Flight Maneuvers
FAA Private Pilot Written Examination (optional)
Career Requirements
Vocabulary

Grade 12:
Advanced Aerodynamics
Advanced Study of Air Traffic Control, Communications and Regulations

Flight Maneuvers Analysis
Advanced Pilotage and Dead Reckoning Procedures
Advanced Navigation
Advanced Radio Navigation
Careers in Depth
Optional:
- Preflight Instruction
- Basic Aircraft Control
- Dual Instruction and Supervised Practice in Required Fundamental Maneuvers and Procedures
- Supervised Solo Practices of Required Maneuvers and Proceadures
- Review and Preparation for FAA Flight test

State: Iowa

Level: Introductory

Course: PRODUCTION

Resource Systems
- Human
- Material Resources
- Energy Resources
- Financial

Management Systems
- Planning
- Organizing
- Controlling

Material Processing Systems
- Separating
- Combing
- Forming
- Conditioning

Power Systems
- Input Energy
- Converting
- Transmitting
- Output (Work)

Communication Systems
- Initiating Information (Sources)
- Transmitting
- Channeling
- Interferring (Noise)
- Receiving
- Using the Information
- Providing the Feedback

Personnel Systems
- Hiring
- Training
- Working
- Positioning
- Retiring

Transportation Systems
- Input Energy
- Propulsion Systems
- Support Systems
- Guidance Systems
- Control Systems
- Suspension Systems
- Structured Systems

Marketing Systems
- Research Markets
- Selling
- Advertising
- Distributing

Outputs
- Goods
- Services
- By Products

Financial Systems
- Receiving (Income)
- Controlling
- Disbursing (Debit)

Course: ENERGY AND POWER-ALTERNATE ENERGY

Formation of the Earth
Introduction to Energy
Energy Conversion
Man and Energy Sources
Energy and Power Model
Electrical Sources
Thermal Energy
Nuclear Energy
Radiant - the Sun
Mechanical and Gravitational Energy
Need for Alternate Energy
  What's Happening Now
  Possible Solutions
  Fossil Fuels
  The Environment
  Resource List
  Alternate Energy Sources
    Wind Energy
    Solar Energy

Course: ENERGY AND POWER-MECHANICAL CONVERSION: SMALL ENGINES

Introduction Systems Concept
Safety
Fire Safety
System of the Vehicle
Introduction of Input
Flow of Fuels
Disassemble Carburetor
Input Processing
Energy Conversion
Procedure for Disassembling a 4-Cycle, 1-Cylinder Engine
4-Stroke Engine
Conversion
Processing
  Simple Machine
  Transmission
Processes
  Losses
  Friction Reduction
  Cooling
Introduction Output
Output Force and Torque
Reassembly

Course: ENERGY AND POWER-MODEL ROCKETS

Introduction to Model Rockets and Packets
Energy and Power Systems
Energy State
Fossil Fuels
Introduction to Construction of Rockets
Energy Conversion
Reaction Engine
Power Output
  Gravity
  Mass, Inertia, & Momentum
  Aerodynamics

Efficiency
Braking System
Weight to Power Ratio
Control and Guidance
Electrical Source: Chemical
Drycells and Conductors

Course: GRAPHIC COMMUNICATIONS CONTENT

Introduction
Graphic Image Generation
  Safety
  Design
  Copy Preparation
  Careers
Reproduction
  Safety
  Image Carrier Preparation
Graphic Image Processing
  Safety
  Assembly
  Finishing
  Packaging
Careers
Graphic Image Management
  Safety
  Storage/Retrieval
  Assessment
  Careers
Others

KENTUCKY

THE PROGRAM OF INDUSTRIAL ARTS EDUCATION IN KENTUCKY SECONDARY SCHOOLS

I. Industrial arts-a point of view
ii. The school administrator and his industrial arts program
iii. the guidance counselor and industrial arts
iv. planning and developing the industrial arts program

A CURRICULUM GUIDE SERIES FOR INDUSTRIAL ARTS
education--Industrial Arts Electricity/Electronics

Outline of Content
Phase A
Basic Electronic Concepts
Sources of Electricity
Electrical Paths
Electrical Loads
Controlling Electricity
Electrical Systems

Phase B
Electrical Measurements
Circuit Analysis
Measuring Instruments Principles
Control of a System
Electrical Company Organization
Electronic System Control Functions
Rectification
Power Supplies
Amplification
Amplifier Coupling Device
Amplifier Circuit Configurations
Frequency Considerations

Phase C
Oscillation
Vacuum Tube vs. Transistor Oscillators
Special Control Device
Integrated Circuits
Communication Systems
Signals and Sources
Transmitters

Phase D
Receivers
Signal Detection
Improving receivers
Frequency Modulation
Special Communication System
Computer
Guidance
Ultrasonics
Radar
Problem Solving Systems

- Computer Types
- Flow Charts
- Analog Circuits
- Analog to Digital Conversions
- Digital Circuits
- Digital Machines
- Assembly language
- Memory
- Integrated Circuits
- Digital Families
- Multivibrators
- Steering
- Programming
- Careers in Electronics

A CURRICULUM GUIDE SERIES FOR INDUSTRIAL ARTS education--Industrial Arts Power Mechanics

Phase A
- Introduction
- Introduction to Power Systems
- Power Generation
- Internal Combustion Engines
- Principles of Power Measurement
- Metric System
- Oil & Lubrication Systems
- Ignition Systems
- Fuel Requirements
- Trouble Shooting
- Engine Analysis
- Review and Evaluation

Phase B
- Power Transmission & Control
- Fluid Power Transmission
- Pneumatics
- Careers in Fluid Power

Phase C
- Lab Orientation
- Heat Engines
- Steam Power Cars
- Environmental Effects
- Careers
- Gas Trubines
- Diesel Engines
- Rotating Combustion Engines
- Rockets
- Airstream Reaction Engines
- Power Measurement
- Engine Sections
- Thrust Augmentation
- Environmental Effects
- Careers

Nuclear Power
Utilization of Power
Review & Evaluation

Phase B
Lab Orientation
Electrical Power Transmission
D.C. Machinery Maintenance and Troubleshooting
Alternating Current Generators
A.C. Motors
Careers
Review & Evaluation

MAINE

INDUSTRIAL ARTS TECHNOLOGY IN MAINE a Resource Guide in Manufacturing/Construction for Elementary and Secondary Schools 1968
(A Study of American Industry)

TO DEVELOP AN UNDERSTANDING OF THE MANUFACTURING AND CONSTRUCTION INDUSTRIES AND THEIR PLACE IN OUR SOCIETY

1.1 Forms of Ownership
- Single Proprietorship
- Partnership
- Corporation

2.1 Levels of Authority
- Top Management
  - President
  - Vice-President
- Middle Management
  - Plant manager
  - Dept. manager
  - Superintendent
- Operating Management
  - Foreman
  - Supervisor
- Worker

2.2 Careers
- Opportunities in Management

3.1 Capital Needs
- Taxes
- Credit and Collections
- Insurance
- Plant
- Labor
- Raw Materials

3.2 Careers
- Underwriter
- Accountant
- Lawyer

4.1 Capitalization of an Enterprise
- Stocks
- Bonds
- Loans

Fixed Capital

Working Capital

4.2 Careers
- Securities sales

5.1 Profit
- Risk
- Profit and Loss

5.2 Careers
Economist

6.1 Gross Profit
Net Sales
Material Cost
Direct Labor Cost
Operating Income
Gross Profit
Overhead
Net Income
Operating Income
Taxes-Federal and State

6.2 Careers
Accountant
Bookkeeper

7.1 Purchase Requisition
Material Needed
Quantity
Delivery Date and Location
Bids
Request
Quotation
Purchase Orders
Quality, Quantity, Price
Invoice
Receiving Report
Payment

7.2 Careers
Buyers
Purchasing Agents

8.1 Basic Research Procedures
Ideas/Problem
Exploration
Screening
Possible solution
Analysis
Decision
Implementation

8.2 Careers
Laboratory Technician
Engineering Technician

9.1 Development
Product
Process

9.2 Careers
Engineer
Model Maker
Architect
Designers-Industrial-Interior

19.1 Packaging
Protection
Promotion
Visual appeal
Information

19.2 Careers
See Advertising

20.1 Direct Selling
Indirect Selling
To Wholesaler-to-retailer-to-consumer
To Retailer-to-consumer

20.2 Careers
Dispatcher
Truck Driver
Salesman

21.1 Liquidation
Filing Legal Documents
Termination Employees
Converting Assets to Cash
Distributing Cash

21.2 Careers
Bookkeeping Worker
Accountant
Securities Salesworker
Lawyer

22.1 Pollution
Conservation
Recycling
Ecology
Resources

22.2 Careers
Environmentalist
Geologist
Conservationist
Ecologist
Engineer

State: Maryland

Level: Senior High

Course: COMMUNICATIONS TECHNOLOGY

Graphic Reproduction
Symbolism and Color
Electronic Multi-media Transmission
Graphic Arts
Drafting
Photography
Video-and/or Audio-graphic Equipment

INDUSTRY AND PRODUCTION TECHNOLOGY

Manufacturing
Construction
Servicing
Researching
Planning
Experimenting
Organizing
Woods
Metals
Plastics
Ceramics
Other Synthetics and Natural Materials

ENERGY AND TRANSPORTATION TECHNOLOGY

Energy Sources
Energy Conversions
Transportation in the Areas of Land, Sea, Air, and Space
Automotives
Power Mechanics
Electricity/Electronics
Fluidics
Pneumatics

State: Minnesota

Level: not specified

Course: ARCHITECTURAL DRAWING

Introduction to Architectural Drawing
Techniques of Architectural Drawing
Planning the House
Basic Architectural Plans
Construction Details
Schedules and Specifications
Estimating and Financing
Building Codes
Electrical Plans
Heating and Air Conditioning
Plumbing
Commercial Architecture (optional)
Model House Construction (optional)

Course: AUTO MECHANICS

Steering and Suspension Systems
Drive Train
Engine Mechanical
Cooling and Heating Systems
Air Conditioning System
Brakes
Electrical System
Engine Tune-up
Fuel and Emission System
Body Adjustments
Exhaust and Lubrication Service

Course: BASIC TECHNICAL DRAWING

Introduction to Technical Drawing
History of Drafting
Freehand Sketching
Lettering
Use of Instruments
Line Weights and Techniques
Geometric Construction
Orthographic Projection
Dimensioning
Scale Drawing
Pictorial Drawing
Sections and Conventions
Auxiliary Drawings
Shop Processes
Charts and Graphs
Developments
Electrical Drawings
Topographical Drawings
Reproduction Processes

Course: COMMUNICATIONS TECHNOLOGY
Introduction to Communications Technology
Telecommunications
Drafting Communications
Graphic Communications
Continuous Tone Photography
Communications Enterprise and the Industrial Arts Student Association

Course: CONSTRUCTION
Managing Construction
Applying Technology to People
Working as a contractor
Collective bargaining
Hiring construction personnel
Training and educating for construction
Working conditions
Advancing in construction
Handling Grievances
Mediating and arbitrating
Striking
Construction Production Technology
Site preparation
Siteing foundations
Building superstructures
Installing utilities
Enclosing framed superstructures
Finishing the project
Completing the site
Servicing the property

Course: CONSTRUCTION PLANNING & MANAGEMENT
Course Overview
The Simple Model
Placing the Building for Environmental Enrichment
Planning the House
Construction Technology
Construction Drafting
Architectural Rendering
Careers
Business and Management

Course: ELECTRICAL/ELECTRONIC TECHNOLOGY
Introduction to Electrical/Electronic Technology
Electronics Industry Definitions
Measurements and Instruments
Symbols, Components, Ratings
Circuit Arrangements
Electrical Relationships
Alternating Current Fundamentals
Capacitive Circuits (D.C. and A.C.)
Magnetism and Magnetic Circuits
Frequency Selective Circuits
Motors and Generators

Residential Electric Wiring
Careers in the Electrical Industry
Introduction to Electronic Applications
Discrete Semiconductor Devices and Circuits
Integrated Devices and Circuits, Analog
Introduction to Digital Electronics
Basic Arithmetic Devices
Basic Support Devices
Basics of Microprocessors
Microprocessor Applications
Careers in the Electronics Industry

Course: ENERGY
What Is Energy
Energy Use
Consequences of Energy use

Course: GRAPHIC ARTS
Introduction to Graphic Arts Technology
Safety
Job Planning and Layout
Design Principles
Methods of Image Generation
Production
Binding, Finishing and Packaging
Marketing
Purchasing and Inventory
Graphic arts plant Operation and management

Course: HOME MAINTENANCE
Introduction
Electricity
Plumbing
Finishing Walls
Structure Maintenance
Concrete and Asphalt
Furniture Maintenance

Course: INDUSTRIAL CRAFTS
Craft Industry
  The Economics of American Crafts
  Marketing Industrial Crafts
  Production
  People in the Industry
  The Consumer
Crafts Planning and Design
Material Process
Material Selection
Craft Material Areas
  Metal
  Wood
  Plastic
Leather
  Jewelry and Gems
  Fibers
  Ceramics
  Graphics
  Composites

Course: MACHINE SHOP
- Introduction to Machine Trades
- Safety
- Measurement and Mathematics
- Hand Tools
- Bench Work
- Blueprint Reading
- Feeds, Speeds, and Rigidity
- Threading
- Cutting Tools
- Drilling and Boring Operations
- Lathes and Lathe Work
- Milling Machines
- Grinding Operations
- Metallurgy and Heat Treatment
- Foundry

Course: MANUFACTURING
- Manufactured Management Technology
- Manufacturing Personnel Technology
- Manufacturing Production Technology

Course: MATERIALS AND PROCESSES TECHNOLOGY
- Introduction to materials
- Introduction to Materials Processing
- Materials and Humanity
  - Materials Consumption
  - Resources, Energy, Ecology and Society
- Student Activities
  - Team
  - Individual
  - Contract Work
  - Community Involvement
- Evaluation and Analysis

Course: METAL TECHNOLOGY
- Metal Materials
- Processes
  - Metal Cutting and Forming
  - Combining and Conditioning
- Application: Manufacturing Finished Products
  - Product Planning
  - Principles and Practices of Assembly
  - Metal Finishing Processes
- Career Opportunities in Metal Technology

Course: PHOTOGRAPHY
- Introduction to Photography
- History of Photography
- Photographic Principle and Theory
- The Camera and Its Elements
- Aperture and Shutter
- Taking Picture, and Film Exposure

Photographic Laboratory Safety
Film Development
Evaluation of Negatives and the Possible Improvement
Making Projection Prints
Print Processing
Evaluation of Prints and the Possible Improvement
Finishing Techniques
Properties and Characteristics of Photographic Materials
Photo-Communications
Negative Making Methods
Photographic Chemistry and Formulas
Creative Darkroom Techniques
Lighting
Photographic Equipment and Materials Selection
Darkroom Design and Layout
Specialized Photography

Course: PLASTICS TECHNOLOGY
Introduction and Orientation
Testing and Chemistry of Plastics
Molding and Forming
Machining
Bonding
Laminates
Encapsulation
Forming Systems
Coating
Dispersion Systems
Decorating
Career Opportunities in Plastic Technology

Course: POWER AND TRANSPORTATION TECHNOLOGY
Introduction to Power and Transportation Technology
Applications of Power in Transportation Systems
Heat Engines
Conversion of Power
Transmission and Control of Power
Atomic
Natural Resources of Power
Research and Development
  Solar
  Fuel Cell
Thermophotovoltaic Converter
  Thermoelectric Converter
  Thermionic Converter
  Magnetohydrodynamic Generator
Careers in Power Technology

Course: SMALL ENGINES

Principles of the Four Stroke Cycle Engine
Principles of the Two Stroke Cycle Engine
Care and Operation of Small Engines
Servicing of External Parts on Small Engines
Carburetor--Principles of Operation
Spark Plugs
Checking Compression
Starting Systems
Oils and Lubrication of Small Engines
Fuels Used in Small Engines
Crankshaft and Tappet Assembly
Checking and Repairing Cylinders
Ini Small
Valves and Valve Repair
Installation of Crankshaft, Piston, Rod, and Ring Assembly
Installation of Crankshaft and Tappet Assembly
Installing Engine Side Cover and Ini Stinger
The Ignition System
Governors and Governor Repair
Installation of Crankcase Breather, Air Cleaner, and Blower Shroud
Final Engine Preparation and Adjustment
Engine Storage
Outboard Motor Repair
Snowmobile Motor Repair
Shop Work

Course: TRANSPORTATION TECHNOLOGY

Introduction to Transportation Technology
Early Development in Transportation
Classification of Technical Systems
  Energy Sources
  Propulsion
  Suspension
  Guidance
  Control
  Support
Terrestrial Modes (Rainbow Route)
Terrestrial Fixed Routes
Stationary Conveyance Systems
Marine Modes of Transportation
Atmospheric Modes of Transportation
Space Transportation and Vehicles
Transportation and the Future
Transportation and Energy
Transportation and the Environment
Occupational Information

Course: [redacted]

Safety
Steel and other Metals
Basic Joints and Welds
Rod and Electrode Selection
Oxy-acetylene Welding and Cutting
Shielded Metal Arc Welding (SMAW)
Gas Metal Arc Welding - Wire Feed (GMAW)
Gas Tungsten Arc Welding (GTAW)
Submerged Arc Welding (SAW)
Heat Shield Welding
Vapour Shield Welding
Testing and Inspection
Plasma Arc Welding
Fabrication Techniques

Course: [redacted]

Standardized Materials of Wood Technology
Safety and Accident Prevention
Processes
Design of Wood Products
Cabinet Construction
Wood Preservation (Finishes)
Career Opportunities in the Wood Industry
Tool Maintenance

Grade: Movement

Level: 9 - 12

Courses: [redacted]

Roads and Road Technology
Introduction
Problem Design
Reading Product Drawings, Planning, Plan or Order of Procedure and/or Methods Study
Safety
Career Opportunities
Human Problems
Road Structure, Properties, and Identification
Road Laboratories
PCC Diffusion Process
Road Fixer and/or Particle Welding
Production Product of Industry
Recidivism Construction

Processes

Road Laboratories
PCC Diffusion
Road Fixer and/or Particle Welding
Production Product of Industry
Road Plastic Inspection (RPC)
Recidivism Construction
Road Structure, Properties and Identification
Automatic Keying Chamber

Courses: [redacted]

*Introduction to Drafting

The Drafting Language
Career Opportunities and Requirements
Materials and Equipment
Specifications and Standards
Design Process
Sketching
Lettering
Drawing Reproduction

*Shape Descriptions - Multiviews

Principle Views
Theory of Orthographic View Relationships
Alignment of Lines
Relevance of Necessary Views
Classifications of Surfaces and Lines
Sections and Conventions
Section Views
Conventions of Section Views
Auxiliary Views

Shape Description - Pictorial

Pictorial Forms and Sketching Techniques
Axonometric Drawings
Oblique Drawings
Perspective Drawings

Size Description

Dimensioning
Drawing Notes
Numerical Control
Production Drawings

Geometry and Location Description

Maps
  Types
  Symbols Used on
Charts and Graphs
  Types
  Common Features of Charts
  Selecting Proper Use

Graphic Geometry

Geometric Construction
Descriptive Geometry--Points & Lines
Descriptive Geometry--Planes
Descriptive Geometry--Revolution

Machine Design

Production Processes and Materials
Fasteners and Fabrications
Machine Elements--Cams, Gears, Springs

Architectural

Home Planning
  Elements of Typical Set of Plans
  House Design
  Building Orientation
  Characteristics of Architectural Styles
  Cost Estimating of Structures
Presentation
Models

Specialized Categories

Electrical and Electronics Drawings
Interconnection and Schematics
Pipe Layouts
Structural Drawing

Course: METALS

Activities Common to All Shipwrecks

General Information
Commonly Used Metals
  Ferrous Metals
  Nonferrous Ferrous
  Steel Identification
  Non-Ferrous Metals
  Space Age Metals
Alloys
Hardness
Metal Finishes

Cuts Metal

General Information
  Safety
  Principles and Elements of Design

Sheet Forming
Surface Shaping
Surface Decoration
Fastening
Machine Forming

Bench Metalwork

Non-Edge Bench Tools
Clamping Tools
Layout Bench Tools
Assembly Tools
Measure and Layout Tools
Drills
Screw Threads
Wrought Iron (Low Carbon Steel)

Metalwork Forging Practices

Safety
Hazards of Heat
Forge Tools
Forming Hot Metals
Industrial Forging
Improvement Opportunities

Metalwork Foundry Practices
Foundry Sands
Tempering Sand
Molds
Patterns
Foundry Metals
Safety
Hazards of Heat
Industrial Foundry Methods
Improvement Opportunities

B-2

Jear Engines
Design and Performance Testing
Transmission and Control

CONSTRUCTION

Building Construction

CRAFTS

Crafts
Ceramics
Lapidary
Leather
Plastics
Metal Jewelry

State: New Mexico

Level: 9 - 12

Course: GENERAL INDUSTRIAL ARTS I
Technical Sketching and Design
Graphic Arts Technology
Electrical and Electronics Technology
Power, Energy, and Transportation Technology
Basic Goods Producing Industries
- Woods Technology
- Metals Technology
- Plastics Technology

The Industrial Arts Student Association

Course: GENERAL INDUSTRIAL ARTS II
Technical Drawing and Product Design
Woods Technology
Metals Technology
- Machine Metals
- Foundry
- Welding

Plastics Technology
Independent Study in Industrial Technology
The Industrial Arts Student Association

Course: ELECTRICITY/ELECTRONICS I
The Science of Electronic
Sources of Electricity
Circuits and Power
Magnetism
Generators and Motors
Inductance an RL Circuits
Capacitance in Electrical Circuits
Tuned Circuits: RCL Networks
Instruments and Measurements
Career Opportunities
The Industrial Arts Student Association

Course: ELECTRICITY/ELECTRONICS II
Introduction and Review
Vacuum Tubes and Semiconductors
Power Supplies
Electron Amplifiers
Electronic Oscillators
Radio Transmitters
Radio Receivers
Television
Electronics in Industry
Test Instruments
Integrated Circuits: Digital and Linear
Career Opportunities
The Industrial Arts Student Association

Course: GRAPHIC ARTS I
Introduction to Graphic Arts Technology
Job Planning and Layout
Image Generation - Cold Composition
Reproduction and Production
Binding, Finishing, and Packaging
Marketing
Purchasing and Inventory
Management and Labor
The Industrial Arts Student Association

Course: GRAPHIC ARTS II
Review of Graphic Arts Technology
Graphic Design Principles
Job Planning
Reproduction and Production
Binding, Finishing, and Packaging
Establishing and Operating a Graphic Arts Firm
Management Practices for the Free Enterprise
The Industrial Arts Student Association

Course: BASIC TECHNICAL DRAWING
Introduction to Technical Drawing
History of Drafting
Freehand Sketching
Lettering
Use of Instruments
Line Weights and Techniques
Geometric Construction
Orthographic Projection
Dimensioning
Scale Drawing
Pictorial Drawing
Sections and Conventions
Auxiliary Drawings
Reproduction Processes
The Industrial Arts Student Association

Course: ENGINEERING DRAWING
Introduction to Engineering Drawing
Review of Basic Principles
Techniques of Design
Precision Dimensions
Threads and Fasteners
Working Drawing
Revolutions
Intersections and Developments
Cams, Gears, and Mechanical Linkages
Reproduction Processes
The Industrial Arts Student Association

Course: ARCHITECTURAL DRAFTING
Introduction to Architectural Drawing
Techniques of Architectural Drawing
Designing the Building
Basic Architectural Plans
Construction Details
Schedules and Specifications
Estimating and Financing
Building Codes
Electrical Plans
Heating and Air Conditioning
Plumbing
Commercial Architecture (Optional)
Model House Construction (Optional)

Course: METALWORKING I
Product Design and Development
Material Identification and Characteristics
Material Processes
Machine Tool Processes
Machine Tool Care
Fastening
Mass Production and Automated Techniques
The Industrial Arts Student Association

Course: METALWORKING II
Review of Metals Technology
Design Principles
Blueprint Reading
Machining Processes
Hot Metal Processes
Machine Tool Care and Maintenance
Coating, Metalizing and Finishing
Mass Production and Automated Techniques
The Industrial Arts Student Association

Course: POWER MECHANICS I
Introduction to Power and Energy Technology
External Combustion Engines
  Steam Turbines
  Steam Generators
Internal Combustion Engines
Electrical Power
Transmission of Power
The Servicing Enterprise and the Industrial Arts Student Association

Course: POWER MECHANICS II
Review of the Principles of Power and Energy Technology
Energy Sources
Power Transmission Systems
Application of Mechanical Systems

Machine and Mechanical Processes
Project or Product Development
Servicing Procedures
Future Transportation Products
The Industrial Arts Student Association

Course: WOODWORKING I
Technology of Woods
  Hardwoods
  Softwoods
  Manufactured Woods
Design Principles, Reading Drawings and Planning
Basic Tool Processes
Wood Product Construction
Finishing
Line/Mass Production
The Industrial Arts Student Association : Wood Product Industries

Course: WOODWORKING II
Principles of Furniture Design and Development
Materials of Furniture Industry
Machine Tool Processes
Tool Maintenance
Cabinet Construction
Mass Production
Finishing
The Industrial Arts Student Association : Furniture Design Studio and Crafts Guild

Course: INDUSTRIAL PLASTICS
Introduction to the Plastics Industry
The Processes of the Plastics Industry
Characteristics of Plastics
Design of Molded Parts
Design of Molds and Dies
Construction of Molds and Dies

State: New York

Level: Secondary

Courses:

[illegible]
Developmental Drawing
- Preparation
- Sketching
- Working
- Drawing
- Charts, Graphs, Maps
- Plot Developments
- Construction
- Careers

Production Drawing
- Working
- Jigs and Fixtures
- Patterns
- Machine Parts
- Assemblies
- Power Transmission
- Manufacturing
- Production Personnel

Architectural Drawing
- Site
- Design
- Floor Plan
- Elevations
- Services
- Industry

Engineering Drawing
- Language
- Tools and Techniques
- Shape Description
- Working Drawings
- Production Processes
- Design Problems
- Industry and Careers

Community Planning
- Land Use
- Regulation
- Types
- Major Considerations
- Perspectives
- Models
- Careers

Advertising Graphics
- Advertising
- Drawing
- Type Layout
- Visuals
- Pages
- Careers

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[redacted]
- [redacted]
  - Charts/Posters
  - Photography
  - Duplication
  - Offset Duplication
  - Publications
  - Job Market
- [redacted]
  - Principles of Photography
  - Cameras
  - Picture Taking Considerations
  - Film Development
  - Printmaking and Enlargement of Paper
  - Specialized Equipment
  - Further Training and Education
- [redacted]
  - Cameras
  - Exposures
  - Film
  - Chemistry
  - Development
  - Prints
  - Evaluation
  - Reproduction
  - Careers and Industry
- [redacted]
  - [redacted]
  - Lithography
  - Copy Preparation
  - Photography
  - Platemaking
  - Duplicating
  - Presses
  - Bindery
  - Careers and Industry
- [redacted]
  - Image Carriers
  - Composition
  - Imposition
  - Presswork
  - Crafts
  - Careers
- [redacted]
  - Preparation
  - Communication Media
  - Photography
  - Processes
  - Industrial Organization
  - Background

Course: [redacted]

[redacted]
- [redacted]
  - Physics
  - Measurement
  - Chemistry
  - Optics
  - Light Rays
  - Reflection and Conversions

Power Generation and Transmission
Industrial Organizations

Electronics
Electron Theory
Meters and Instruments
Inductance and Capacitance
Tubes and Semi-Conductors
Amplifiers-Oscillators
Radio and Television
Controls and Computers
Careers and Industry

Consumer Electronics
Basic Electricity
Test Equipment
Appliance Functions
Repair Functions
Wash Appliances
Dryer Appliances
Air Appliance
Refrigeration Appliances
Accessories

Consumer Electronics
Audio Theory
Measurement
Electronics Components
Sound Distribution
Amplifiers and Recorders
Sound Systems
Electronic Controls
Careers

Communications Electronics
Basic Audio Theory
Careers
Communications Theory
Communications Instruments
Television
Microwave Communications
Light Communications
Business Careers

Digital Electronics
Digital Theory
Digital Logic Circuits
Digital Techniques
Integrated Circuits
Logic Circuits
Micro Process or Systems
Careers

Small Engines
Introduction
Fuel Systems
Lubrication
Cooling Systems
Ignition Systems
Care and Maintenance
Power Transmission
Industry and Careers

16.1

[illegible]
- [illegible]
- Diesel Engines
- Rotary Engines
- Maintenance
- Power Transmission
- Industrial Applications

[illegible]
- Bushing
- Purchasing
- Assembly
- Forward Maintenance
- Secondary Maintenance
- Major Maintenance

[illegible]
- Motor Fuels and Oils
- Retarding
- Accessories
- Purchasing
- Assembly
- General Maintenance
- Specialized Maintenance

[illegible]
- Electric
- Machines and Power Transmission
- Small Engines
- Vehicle Engines
- Synthetics
- Engine Electricity
- Turbines and Industry

[illegible]
- Vehicles
- Freight
- Piston Engines
- Gasoline Engines
- Diesel Engines
- Space Vehicles
- Industrial Applications

[illegible]
- Vehicle Design
- Basic Concept
- A.C. Electrical Vehicles
- A.C. Gears
- A.C. Frames
- Brakes
- Other Systems

[illegible]
- Energy Sources
- Conventional Energy Sources
- Alternate Forms of Energy
- Gas Fuels
- Energy Use
- Circumstances
- Conventional Conversions
- Mechanical Conversions

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Course: WOOD TECHNOLOGY

Standardized Materials of Wood Technology
  Formation Anatomy and Properties of Wood
  Physical Nature of Wood Nonmechanical Properties
  Degrade of Wood Materials
  Wood Composites
  Millwork and Molding
  Hardware
  Fasteners
  Adhesives
Safety and Accident Prevention
Processes
Design of Wood Products
Cabinet Construction
Wood Preservation (Finishes)
Career Opportunities in the Wood Industry
Tool Maintenance

Course: PLASTIC TECHNOLOGY

Introduction and Orientation
Testing Chemistry of Plastics
Molding and Forming
Machining
Bonding
Laminates
Encapsulation
Foaming Systems
Coating
Dispersion Systems
Decorating
Career Opportunities in Plastic Technology

Course: METAL TECHNOLOGY

Metal Materials
Processes
  Cutting and Forming
  Combining and Conditioning
Application: Manufacturing Finished Products
  Product Planning
  Principles and Practices of Assembly
  Metal Finishing Processes
Career Opportunities in Metal Technology

Course: INDUSTRIAL CRAFTS

Craft Industry
Craft Planning and Design
Material Processes
Material Selection
Craft Material Areas

Course: CRITICAL TECHNICAL PROBLEMS (samples)

Wood Technology
- Anatomical Structure of Wood
- Forest Ecology
- Physical Nature of Wood
- Wood Defects
- Lamination Processes
- Peg Diffusion
- Wood Plastic Composition
- Residential Construction
- Commercial Construction
- Wood By-Products
- Product Design
- Product Finishing
- Preservation Materials
- Occupations - Present and Future
- Safety Development
- Prototype Construction
- Bending Fixtures

Metal Technology
- CAM
- Chemical Milling
- Explosive Forming
- Adhesives
- Investment Casting
- Forging
- Heat Treatment of Metals
- Metal Turning
- Extrusion Processes
- Powder Metallurgy
- Multi-Axiated Problems
- Automation
- Accident Prevention Study

Plastic Technology
- Mold Construction
- Decorating and Finishing Applications of Plastic
- Study Developments of Future Applications of Plastic
- Uses of and Choices of Bonding Agents
- Plastic Products
- Study of Optical Properties
- Plastic Products
- Safety and Health Hazards of Toxic Fumes from Plastic Materials

Course: ENERGY SOURCES
- Introduction to Energy Sources
- Chemical Energy
- Electrical Energy
- Light Energy
- Mechanical Energy
- Nuclear Energy
- Thermal Energy
- Careers in Energy

Courses: [illegible]
Introduction
Conversion of Power
  External Combustion
  External Combustion
Transmission of Power
  Mechanical
  Fluid
Atomic
  Fission
  Fusion
Research and Development
  Solar
  Fuel Cell
  Thermoelectronionic Converter
  Thermionic Converter
  Magnetohydrodynamic Generator
Careers in Power Technology

Courses: [illegible]
Introduction to Electrical/Electronic Technology
Electronics Industry Reflections
Measurements and Instruments
Symbols, Components, Ratings
Circuit Arrangements
Electrical Relationships
Alternating Current Fundamentals
Capacitive Circuits (D.C. and A.C.)
Magnetism and Magnetic Circuits
Frequency Selective Circuits
Motors and Generators
Residential Electric Wiring
Careers in the Electrical Industry

Introduction to Electronic Applications
Discrete Semiconductor Devices and Circuits
Integrated Devices and Circuits, Analog
Introduction to Digital Electronics
Basic Arithmetic Devices
Basic Support Devices
Basics of Microprocessors
Microprocessor Applications
Careers in the Electronics Industry

Courses: [illegible]
Introduction to Transportation Technology
Early Developments in Transportation
Classifications of Technical Systems
Terrestrial Modes (Rubber Tired)
Terrestrial Fixed Guide
Stationary Conveyance Systems
Marine Modes of Transportation
Space Transportation and Vehicles
Transportation and the Future

Transportation and Energy
Transportation and the Environment
Transportation Information

Courses: [illegible] (Sample Line)

Energy Sources
Geothermal Production
Solar Heating and/or Cooling
Solar Photovoltaic Banks
Wind or Water Energy Conversion Systems
Energy Storage Systems

Power Technology
Drilling Engine/Mean Pump
Steam Engine
Thermodynamics Air System Analysis
Hydraulic/Pneumatic Controls

Electrical/Electronic Technology
Amateur Radio
Alarm Systems
Possible Shooting Communications Equipment
Motivator and Other Microprocessor Control Units

Transportation Technology
Electrical Vehicle Propulsion
Linear Induction Motor Propulsion
Air Suspension Systems

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[redacted]

Course: [redacted]

Level: 9 - 12

Courses: [redacted] (9 - 0)
[redacted]
Design
Preparing to Build
Clearing a Site
Excavation
Compaction of Concrete
Construction of Forms, Reinforcing, and Finishing Concrete
Masonry
Framing a Job
Wood Frame Construction
Electrical Wiring
Plumbing

Courses: [redacted] (9 - 0)
[redacted] and Design
Setting a Job
Materials and Processes
Casting and Molding
Forming Technology
Machining
Assembling
Finishing
Industrial Product Management
Personnel Management

Courses: [redacted] (9 - 0)
History of Transportation
Land Transportation
  Local and Suburban Transit
  Highway Transportation
  Rail Transportation
  Access and Intermodal Integrating
Aerospace Transportation
  Aviation
Water Transportation
  Inland Water Transportation
Future Transportation
Occupations in the Transportation Cluster

Courses: [redacted]
Broadcasting
  Television
  Radio
Publishing
  Graphic Arts
  Journalism
  Commercial Art
Audio/Visual
  Video Technique Film Processing
  Fundamentals of Photographic Printing

Line Telecommunications
Development of the Telephone
Telephone Administrations
Data Products Ltd

Chapter Electricity and Electronics (8 : 10)
The Industrial Revolution
Classification of Materials
Finding Materials
Separating Materials
Fabricating Materials
Finishing Materials
Development of Products

Chapter Electronic Communications (8 : 10)
Introduction to Visual Communication
Photographic Communication
Printed Graphic Communication Techniques
Television Graphic Communication
Communication Considerations
The Communication Industries

Chapter Fluids and Energy (8 : 10)
Introduction to Power and Energy
Mechanical Systems
Introduction Fluid Power
Pneumatic Systems
Hydraulic Systems

Chapter Modern Materials (11 : 12)
Metal Products (11 : 12)
Production Project (11 : 12)

Course: Chapter

Level: Not Specified

Lesson: [illegible]
Introduction
Maximum Energy Savings and Applications
Personal Communication Conventions
Personal Communication Conventions
Electrical Conventions
Transmittance and Control of Power
Assessment of World Energy Sources and Conservation Practices

Lesson: [illegible] Exercises and Assignments
Introduction
Personal Shop Safety
Work Area Practices
Tools and Fluids Conventions
Personal Hand Tools

Lesson: [illegible] of Computer Aided
Shop Safety
Communications Model
Elements of Printing
Font Methods of Printing
Kinds of Logo in Graphic Arts
Typography
Type Characteristics
Type Photography
Point-up Enlargement
Design by Enlargement
Graphic Arranger
Logo/Personal Preferences
Photo-Color Enhancement
Business Card
Spec Assignment

Lesson: [illegible] Exercises & Activities
Introduction to Advanced Woodworking
Introduction to the Woodworking Industry
Planning and Designing
Selecting and Laying Out Materials
Planing and Making Stock to Size
Laminating Wood Joints
Assembling Materials
Product Construction

Author: Pennsylvania

Level: Not Specified

Contents: [illegible]

Energy Sources
The Nature of Energy and Power
Fossil Fuels
Mechanical Advantage
Gears
Cams
Belt
Sprockets

Energy Conversion Devices
Internal Combustion Engines
Reciprocating 2 & 4 Cycle Spark Ignition Engines
Principles Governing Operation of Internal Combustion Engines
Refers to the Laboratory
The Two and Four Stroke Cycle Engines
Operation of 2 & 4 Cycle Engines
Power Control
Ignition
Compression
Cooling System
Lubrication
Displacement
Performance of 2 Cycle Engines
Performance of 4 Cycle Engines
Applications
Environmental Impacts
Career Opportunities
Reciprocating 2 & 4 Cycle Compression Ignition Engines
Principles Governing Operation of Diesel Engines
Refers to the Laboratory
Operating Principles of 4 Cycle Diesel Engines
Operating Principles of 2 Cycle Diesel Engines
Fuel Injection Systems of Diesel Engines
Fuel Injectors
Diesel Fuel
Comparison Pressure to 4 Diesel Engines
Operation of 4 Diesel Engine
Cooling and Power Measurements
Performance
Diesel Engine Maintenance
Comparison of Diesel and Spark Ignition Engines
Applications
Environmental Impact
Career Opportunities
Rotary Engines
Historical Background of Rotary Engines and Comparison to Recip-
Operating Engines
Refers to the Laboratory
The Wankel Engine
Power Control in Rotary Engines
Operating Cycle Used
Power Measurements

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  - [illegible] of Whole and Reorganizing Agrees
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    - [illegible] Principle of Open Core Road Systems
    - [illegible] to Its Locations
    - [illegible] and Networks of Road Systems Sequences
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    - [illegible] Principle of Open Core Reorganizing Road Agrees
    - [illegible] to Its Locations
    - [illegible] and Networks of Reorganizing Road Agrees
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Leather Craft
- History and Early Uses of Leather
- Processing Leather
- Modern Processing Methods
- Geographical Sources of Leather
- Tool and Equipment
- Special Activities
  - Boy Scout Projects
  - Camping Uses
  - Hobby Crafts

Plastics
- Introduction and History
- Demonstration, Projects and Design-Based on the following Material and Processes
  - Sheet Plastics Fabrication
  - Vacuum Forming and Flow Forming
  - Mechanical Stretch Forming
  - Cutting and Machining
  - Sanding and Buffing
  - Expendable Bead Form
  - Resin Form
  - Surface and Internal Carving
  - Dying and Painting
  - Thermoformation of Pellets and Powders
  - Fiber Glass Lamination
  - Vinyl Plastisol Casting
  - Polyester Casting and Embedding
  - Compression Molding
  - Injection Molding
  - Molding and Joining
- Usage of Plastic
- Evaluation

Course: SHEET METAL
- General Introduction to the Shop and its Tools
- Planning
- Layout Equipment
- Layout Methods
- Cutting Metals
- Metal Working Tools
- Drilling
- Fastening Sheet Metal
- Finishing and Polishing
- Safety Instruction

Course: BENCH METAL
- Power Tools used in Bench Metal
- Hand Tools used in Bench Metal
- Operations used in Bench Metal
  - Bending and Twisting
  - Threading
  - Fastening Metals
  - Assembly Tools
- Heat Treatment
- Safety Instruction

Course: [redacted]

Lathe
Shaper
Milling Machine

Course: [redacted]

Materials and equipment
Techniques
Learning Activities
Safety

Course: [redacted]

Equipment
Safety
Bad Sizes and Types
Techniques
Learning Activities
Special Equipment and Techniques

Course: [redacted]

A Special Unit in Foundry Safety Must Be Introduced before the students Start working with Metals metal
Pattern Making
Foundry Sand
Crucibles
Flask
Impurities of Metal
Common [redacted] Used in Foundry Area
Melting Points of Metals Commonly used in school Foundries

Course: [redacted]

Power
Internal Combustion Engines
Other Internal Combustion Engines
External Combustion Engines
Electrical Energy
Atomic and Solar Energy
Miscellaneous Laboratory Experiences with Small Power Units
  Engine Tune-up and/or reconditioning
  Engine repair and broken part replacement
  Rotary lawn mower blade sharpening and balancing
Engine operating--period maintenance
  Preparation of power units for off-season storage
  Removal of power units from storage
  Automobile power periodic inspection and maintenance
  Preparation of automobile for cold weather operation
  Preparation of automobile for warm weather operation
  Measurement and calculation of horsepower
  Measurement of two-stroke cycle engine crankcase pressures
  Trace flow of power through motor driven gear train and calculate speed of each gear to final drive
Miscellaneous activities related to power mechanics

Course: [redacted]

Introduction
Reading a Drawing and Planning
Wood as a Material
Hand Tools
Glues and Adhesives
Mechanical Fasteners
Safety
Power Tools and Millroom Machines

Course: [illegible]

Level: 9 - 12

Courses: [illegible]
[illegible] Technology
The Construction Industry
Site Types and Processes
Labors and Manual Types and Uses
Portable Construction Mechanics
Material Types and Uses
Plans Types and Uses
Opportunities in the Construction Industry
Training and Educational Opportunities
Current Opportunities
Personnel Requirements

Courses: Crafts
Planning, Sketching, and Designing
with Metal
Graphic Arts
Plastics Crafts
Wood Crafts
Leather Crafts
Ceramic Crafts
Opportunities in Craft Industries

Courses: [illegible] & Design
Fundamentals of Drafting
Maps and Plan Descriptions
Working Drawings
Auxiliary views and Sections
Pictorial Drawings
Fastening Devices
Mechanical Movements
Surface Developments and Intersections
Specialized Drafting Areas
Architectural
Electronics
Descriptive Geometry
Technical Drafting
Graphs and Charts
Technical Illustrations
Opportunities in Drafting Careers

Courses: [illegible]
The Electrical/Electronics Industry
Fundamentals of Electricity/Electronics
Direct Current and Alternating Current
Electric Circuits
Magnetism and Electromagnetism
Inductance and Capacitance
Generators and Motors

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Courses: [illegible]
- [illegible]
- Technology of Wood
- Framing and Designing Principles
- Wood Joint Processes
- Machine Tool Processes
- Abrasive Processes
- Forming
- Preparation of Wood and Applications
- Hardware
- Gas Materials and Processes
  - Plastic Laminate
  - Wood Lamination and Bending
  - Processes Treated Wood Finishing and Preserving
- Opportunities in the Wood Industries

Courses: [illegible]
- for Manufacturing and Construction Industries
- Framing and Designing
- Materials and Processes
  - Metals
  - Plastics
  - Ceramics
  - Metals
- Research and Experimentation
- Opportunities in Manufacturing and Construction Material Processing

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Courses: [illegible]

The Printing Industry
Introduction to English Communication
Composition
Layout and Design
Lithography
Offset Lithography
Process Camera
Strong Printing
Print Processing

Courses: [illegible]

Introduction
Duplicating
Metric System
Planning Planning
Planning Aids in Mathematics
Measurement and Layout
Paper Work
Metric - Customary Power Tools
Mechanics
Air Brakes
Welding
Sheet Metal
Int. Metal
Finishing

Courses: [illegible]

Concepts
Physics - Relationship of energy and power
Properties
Mechanical Power
Transportation
Aerodynamics
Lasers
Transmissions

Courses: [illegible]

Basic Energy
Non-Fossil
Energy Conservation
Nuclear Energy
Solar Power
Water Power
Wind Energy

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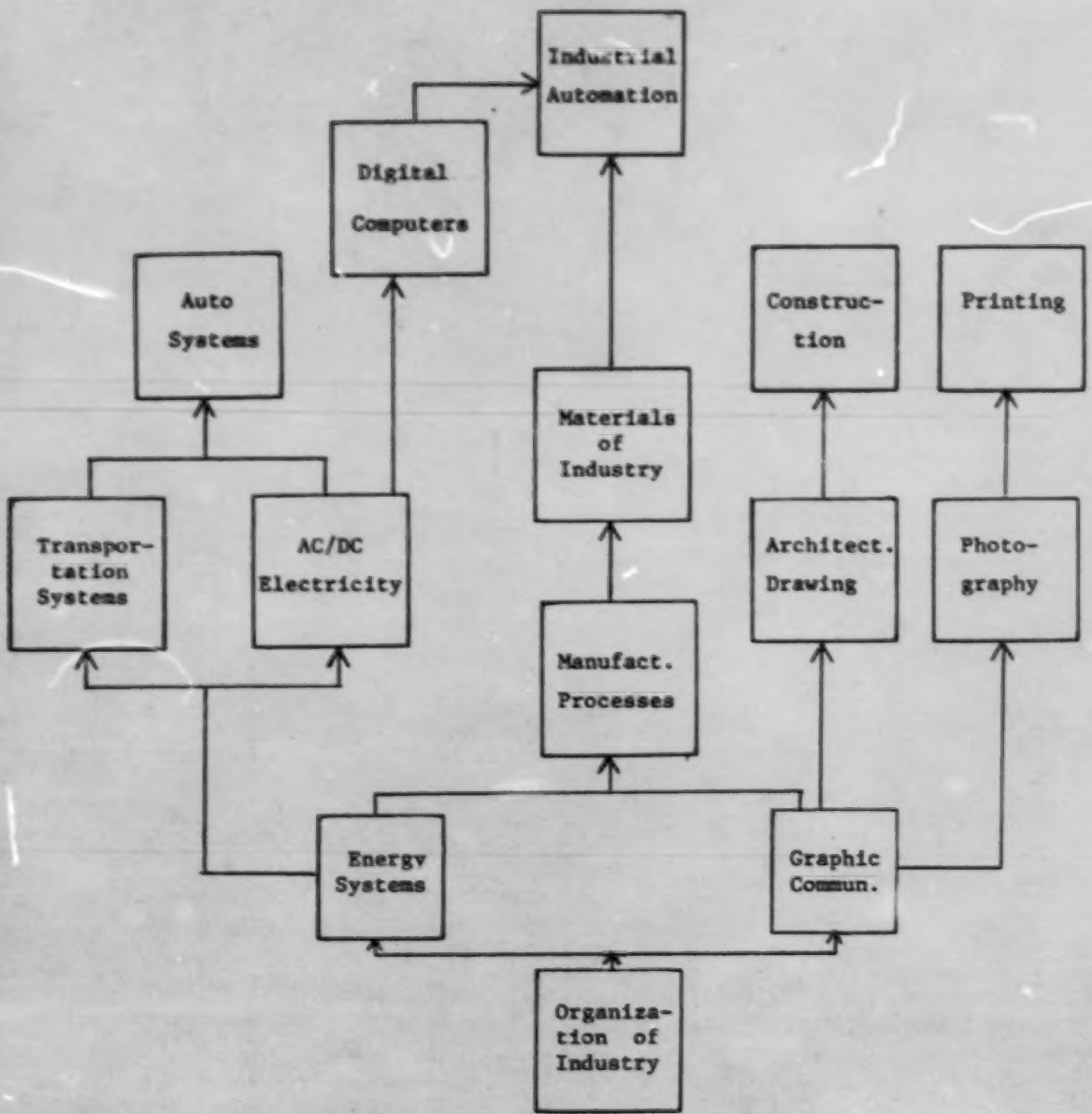
A minimum of three years of industrial arts coursework should be available beyone grade 8. Courses covering topics related to all five clusters should be provided. These courses should represent a logical sequence of knowledge acquisition yet permit increasing levels of specialization. Figures 13 and 14 represent a structured sequence of semester courses which could constitute a high school industrial arts program. Notice that a student desiring to take industrial automation might complete:

Sem. 1, grade 9 - Organization of Industry
Sem. 2, grade 9 - Energy Systems
Sem. 1, grade 10 - Graphic Communications
Sem. 2, grade 10 - Manufacturing Processes
Sem. 1, grade 11 - AC/DC Electricity
Sem. 2, grade 11 - Materials of Industry
Sem. 1, grade 12 - Electronics & Computers
Sem. 2, grade 12 - Industrial Automation

Figure 13 Sequence of Courses in a Structured Industrial Arts Curriculum



State: Georgia

Level: 7 - 9

Course: COMMUNICATIONS

Orientation to Communications
- Introduction to the Course
- Historical background of Communications
- Student Responsibilities
- Vocational Guidance

Graphic Communications (Printing and Photography)
- Graphic Design
- Relief Printing
- Planographic Printing
- Screen Printing
- Intaglio
- Spirit Process
- Electrostatic
- Infra Red
- Binding
- Photography

Electronic Communications
- Development of Electrical Communications
- Development of Electronic Communications
- Radio
- Television
- Military

Visual Communications (Drafting)
- Types of Drawings and how they are used
- How Drawings become Reality
- Starting to Draw
- Measuring
- Dimensioning
- The tools of the Draftsman
- Drawing mechanically
- Drawing to Scale
- Types of Pictorial Drawings
- Other Type Drawings

Course: POWER AND TRANSPORTATION

- Introduction
- Historical Background and Development of Power
- Safety
- Energy
- Mechanical Power
- Electrical Power
- Fluid Power
- Power Systems of the Future
- Transportation
- Careers

Course: CONSTRUCTION

Course: CONSTRUCTION

Orientation to Construction
Management of Construction
Construction Trades
  Masonry
  Rough Carpentry
  Heating and Air Conditioning
  Electricians
  Plumbing
  Finish Capentry
  Serviceperson
Specialized Construction Trades
Landscaping
Community Development

Course: MANUFACTURING

Orientation
Organization of Industry
Sketching
Research and Development
Design
Planning
Measurement and Layout
Cutting to Rough Size
Cutting to Exact Size
Assembling and Fastening
Finishing
Industrial Maintenance
Product Engineering
Patents
Production
Marketing
Finance and Control
Personnel Administration
External Relations
Secretarial and Legal Affairs

10.1 Engineering Functions
Product Design
Engineering Testing
Product and Process Improvement
Consultations

10.2 Careers
Engineering Occupations

11.1 Employment Recruiting
Advertising
Agencies
Schools
Walk-ins
Employment Needs (industry)
Terminations (employee)
Expansion
Employment Needs (individual)
Occupational Preference
Career Pattern and Life Style
Education and Training

11.2 Careers
Personnel Management

12.1 Employee Classification
Rate Determination
Merit Ratings
Supplemental Compensation
Work Schedule Control

12.2 Careers
Personnel Administrator
Wage and Salary Administrator

13.1 Union Relations
Economic Rewards
Labor Union History
Collective Bargaining
Agreements
Grievances
Mediation
Strikes
Settlements
Laws

13.2 Careers
Negotiator
Arbitrator
Mediator
Business Agent

14.1 Working Conditions and Advancement
Physical Environment
Social Environment
Economic Rewards

14.2 Careers
Industrial Relations Personnel

15.1 Public Relations Activities
Community
Government
Shareholders
General Public

15.2 Careers
Director of Public Relations

16.1 Safety Program
Accident Prevention
Benefit Program
Insurance
Retirement
Unemployment
Holidays
Profit Sharing
Training Program
Vestibule
Apprenticeship
Cooperative

16.2 Careers
Safety Director
Training Director
Recreation Director
Employee Services Director

17.1 Marketing Research
Historical
Survey
Experimental

17.2 Careers
Market Analyst
Market Research Personnel

18.1 Types of Advertising
Product
Attract attention
Inform
Persuade
Cause action
Ideas/Company
Promotion
Name recognition

18.2 Careers
Advertising Layout Person
Designer
Commercial Artist
Photographer

Heat Treatment

Metal Composition
Safety
Types of Furnaces
Metal Quenchs
Heat Treating Processes
Hardness Testing
Industrial Application
Occupational Information

Machining Metals

Machine Planning
Safety
Drilling
Metal Cutting
Machine Lathe
Set-up Tools
Milling Machine
Grinding
Shaper
Machine Occupations
Quality Control
Automation Machining
Reaming

Sheet Metal

Types of Sheet Metal
Job Design and Planning
Measure and Layout Tools
Pattern Development
Cutting Sheet Metal
Bending Sheet Metal
Fastening Sheet Metal
Finishes for Sheet Metal
Spining Sheet Metal
Safe Sheet Metal Practices
Occupational Opportunities

Welding

Oxyacetylene
Metallic ARC Welding
Tungsten Inert Gas (TIG)
Metal Inert Gas (MIG)
Resistive Welding (SPOT)
Other Welding Processes
Occupational Opportunities

MONTANA
INDUSTRIAL ARTS CURRICULUM GUIDE

Materials

Metals
- Bench Work
- Sheet Metal
- Introductory Machining, Welding and Casting
- General Welding
- Oxyacetylene Welding
- Arc Welding
- Advanced Welding

Plastics
- Hand Processes
- Casting, Moulding and Laminating
- Fiberglass

Woods
- Hand Tool Processes
- Machine Processes
- Cabinetry and Millwork

COMMUNICATION

Drafting
- Drafting Processes
- Mechanical Drafting
- Pictorial Drawing
- Descriptive Geometry and Pattern Development
- Architectural Drafting
- Surveying and Mapping

Graphic Arts
- Printing Processes
- Relief Printing
- Screen Printing
- Light, Lenses, Film and Paper
- Exposure, Composition and darkroom
- Pianographic Printing

Electronics
- Electronic Devices and Systems

ENERGY

Electrical
- Electrical Technology
- Electrical Circuits
- Electromagnetics
- Circuit Applications

Mechanical/Fluidics
- Energy Sources and Technology
- Small Engines

State: NORTH DAKOTA

Level. Senior High

Course: DESIGN/DRAFTING

Instruction and History to Drafting
Review of Freehand and Instrument Drafting
Geometric Construction
Orthographic Projection
Dimensioning (English and SI Metric)
Pictorials
Sections and Conventions
Auxiliary Views
Production Drawing
Charts and Graphs
Specialized Drafting:
  Construction
  Mechanical
  Electrical
  Topographical
  Etc.
Reproduction Processes
Techniques of Design
Precision Dimensions
Threads and Fasteners
Revolutions
Intersections and Development
Technical Illustrations
Cams and Gears
Technical Document Control Systems

Course: PHOTOGRAPHY

Introduction to Photography
History of Photography
Photographic Principle and Theory
The Camera and Its Elements
Aperture and Shutter
Taking Picture, and Film Exposure
Photographic Laboratory Safety
Film Development
Evaluation of Negatives and the Possible Improvement
Making Projection Prints
Print Processing
Evaluation of Prints and the Possible Improvement
Finishing Techniques
Properties and Characteristics of Photographic Materials
Photo-Communications
Negative Making Methods
Photographic Chemistry and Formulas
Creative Darkroom Techniques
Lighting
Photographic Equipment and Materials Selection
Darkroom Design and Layout
Specialized Photography

Course: GRAPHIC ARTS

Review the Level I course, Graphic Communication Technology units of:
- Design
- Image Generation
- Preproduction
- Production
- Bindery
- Careers

Job Planning
Design Principles
- Message Analysis
- Design
- Layout

Methods of Image Generation
Preproduction Methods
Production
- Relief
- Offset
- Gravure
- Screen
- Duplicating

Bindery, Finishing, and Packaging
Characteristics and Manufacturing of Materials Used in Graphic Arts
Reprographics Process Trouble Shooting
Graphic Arts Plant Operation
Career Opportunities

Course: CONSTRUCTION DRAFTING

Introduction to Construction Drafting
Review of Drafting Procedures
Building Codes and Office Practices Used
Plot or Site Plans
Floor Plans and Utility Planning
Foundation Plans
Elevations
Construction Details
Presentation Drawings
Career Opportunities in Construction Drawing

Course: [ESSENTIAL TECHNICAL PROBLEMS: GRAPHIC COMMUNICATIONS
(SAMPLE LEARNING TOPICS)]

DESIGN/DRAFTING:
Aerospace Engineering
Civil Engineering
Electrical/Electronic Engineering
Geological Engineering
Mechanical Engineering
Marine Engineering
Nuclear Engineering
Production Industry

PHOTOGRAPHY:
Photography Education
Basic Densitometry
Characteristics and Applications of Various Photographic Materials
Basic Scientific Photography
Portrait Photography
Color Theory and Color Photography
Safety and Health Hazards with Photographic Chemicals
Career Opportunities in Photography Related Industry
GRAPHIC ARTS:
Photo-Offset Process
Advanced Screen Printing Techniques
Color Separation and Reproduction
Reproduction Techniques for Audio-Visual Materials
Modern Image Generation Methods
Special Effect Reproduction
Advanced Layout and Design
Market and Cost Analysis
CONSTRUCTION DRAFTING:
Advanced Construction Drafting Education
Planning and Design Considerations
Resource Materials for Construction Drafting
Color Illustrations and Presentations
Architectural Model Making
Interior Design

Appendix B

A Review of Industrial Arts

Topics Included in a Sample of

Available Textbooks

APPENDIX B
CATEGORIZATION of TEXTBOOKS by CLUSTERS

Textbooks are categorized according to entry number of bibliography. The numbers enclosed by () indicate the chapters, sections, or units of the designated text.

GRAPHIC COMMUNICATIONS

HISTORY	PRINTING	PHOTOGRAPHY	DESIGN	MECHANICAL DRAFTING
2(1)	11(28)	12(12)	25(p.124/134)	2(2/15,17/20)
10(1)	12(2/6, 8/11, 14)	59(9)	40(59)	6(1/15)
32(5/6)	36(28)	74(4/7)	47(19/23)	8(1/11,13/15)
34(3/4)	58	75	59(6)	9(4/8)
35(2/3)	59(1/2, 4/5, 7/8,10/15)	89(6)	66(3)	10(2/25)
47(37/39)	66(3,4/13)	103(9/16, 18)	74(2)	11(2/20,24/27)
58(1,3)	74(3,8/12)	105(9/12,17/18)	89(3)	15
59(3)	76(18/27)	111(19/21)	101(2/3)	20
66(1)	77(6)	117(14)	103(5,17)	21
70(31)	89(1,4/5,7/11)	118(14/15)	105(5)	22
89(2)	97(25)		111(8/11,35/36)	23
91(2)	99(20)		117(13)	24
97(1/2)	103(3/4,6/8,19/26)		118(13)	25
101(1)	105(6/8,13/16,19/26)			26
103(1/2)	108(7/24)			27
105(1/2)	111(3/7,12/13,16/18, 22/34)			28
108(1/6)	117(4/12,16/18)			29
111(1/2, 8/12)	118(4/12,16/18)			30
117(1/3)	126(p.176/183)			31
118(1/3)	134(50)			36(1/24,26/27)
126(p.7/13)				37
				47(1/18,24/33)
				76(6/17)
				77(3/5)
				79
				91(1,3/22)
				97(3/11,13/19,21, 23/24,26)
				98
				99(1/15,17/18,21/22)
				100
				101(4/20)
				109
				110
				126
				127

ARCHITECTURAL DRAFTING	CIRCUIT DESIGN	COMPUTER GRAPHICS
8(12)	2(21)	2(16)
11(22)	11(23)	11(21)
36(25)	97(20)	23(p.113/117)
47(34/36)	98(p.101/108)	24(p.114/120)
70(1/30)	99(16)	25(p.121/122)
90	100(p.41/42)	26(p.83/85)
97(22)	101(21)	27(p.85/87)
98(p.114/120)		28(p.84/86)
99(19)		97(12)
100(p.53/57)		
134(1/49,51/53)		
135		

Radio & TV was not covered in the textooks.

MANUFACTURING

PURPOSES & ORGANIZATION

4(35)
13(47/50)
32(1/2,4,41/42)
34(2,39/42)
38(1/4)
40(1/7)
42(67)
44(4)
48(8/9)
49(1/3,42)
61(1)
63(1)
65(1)
77(1/2,7,39/43)
78(1)
104(1/5)
113(21,26)
119(1)
121(p.31/34,137/191)
123(p.7/28)
124(p.6/19)
133(1/4,19A,20A/C, 20E,21B/22, 25-1/4,27-1/8 29-1,30-4/33)
139(6)
5(1)
14(7)
33(1,3,27/28)
35(1,30/31)
39(1,4,65/67)
41(1/3,5)
43(7/8,68/71)
46(2,54/55)
48a(5,46/47)
60(1/3,31)
62(1/2,4)
64(1/2)
76(1/5,59,65, 106/110)
94(1,15)
106(63/64)
115(21)
120(A,2,3)
122(p.13/15, 54/72)
132(1/4,12/16, 18,20/34)
136(p.27/28,154/157)
137(p.2/24,86/94)
138(14)

RESEARCH & DEVELOPMENT

5(2)
32(8)
35(29)
39(2/3)
40(17/21)
41(4,17/21,30)
42(69/71)
43(77)
44(28,31)
46(49)
48a(1/4)
60(69/72,75/76)
61(15,18)
62(3)
64(10/13,93/100)
68
76(69)
120(4,46)
132(17)
133(17A/C,24-1/3)

PLANNING & SCHEDULING

5(2)
13(1/7)
32(8/10)
34(6/7,43)
35(5)
38(16/18)
39(15/19)
41(22)
42(1/7)
43(1/6)
44(1/3)
46(1,4/5,59)
48(1,3)
48a(10/12,22)
49(4/6,8/11)
60(5/7,45)
61(2,16)
62(5)
64(2/3)
76(68)
87(1)
102(1/6)
113(1/3)
115(1)
120(6)
121(p.19/30)
122(p.6/12)
133(12/15,18A/C,18E, 20D, 24,25-6/26-5,28-1,5,6)
136(p.18/26)
137(p.14/20,25)

AQUISTIONS & INVENTORIES

13(51/53)
32(7,40)
33(2)
34(1,5,38)
35(4,28)
38(5/10,13/15,68)
39(5/9,68/69)
40(8/16)
41(7/16,58)
42(64/66,68)
43(72/76)
44(29/30)
46(3,50/53,56/57)
48(2)
49(7,43)
60(4,44)
63(4/6)
64(3/9,109/111)
65(2/3)
67(1/7)
76(28/31,66/67)
77(17)
87(2)
94(3)
104(36/37)
106(54/62)
113(25)
115(25)
119(2)
120(1,19)
121(p.17/18)
122(p.3/5)
123(p.365/376)
124(p.79/80)
133(17F,21A,30/43)
136(p.7/17)
137(p.3/13)

PROCESSING & MACHINING

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12(7,13)
18(9/11)
34(9/13,15/23,36/37)
38(19/55,64/67,69/72)
41(23/41,46,48/49)
43(9/15,17/27,56/67)
48(4/5,7)
60(8/10,12/14,17/21 23/28,32/34,36/38, 41,46/51,54/62, 77/98)
76(32/49,60/62,70/77)
87(3)
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108(23)
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122(p.17/29,33/40, 43/48,51/52)
126(p.198/211)
133(5/9)
138(1/13)
4(1/34)
13(8/13,33/46)
32(3,11/25,30/32, 36/39)
39(20/38,44/55,64, 70/72)
44(6/15,21/27)
48a(23/37)
61(3/13,19/26)
63(7/33)
64(15/48,56/59,61/89, 104/108,112)
77(8/12,18/20)
94(2,4/11,13/14,16/28)
104(6/19,30/35)
113(4/6,11/20,22)
120(5,7/13,15/17,20/28, 33/45,47)
123(p.29/312,317/394, 403/462)
136(p.34/96,132/136)
139(1/2,4/5)
5(3/10)
14(1/6)
33(4/15,17/19,21)
35(6/15,20/21,25/27)
40(22/41,48/51,58)
42(8/30,51/63)
46(6/37)
49(12/24)
62(6,13/19,22/30, 33/95,97)
65(4/22,24/25)
73(49/59)
78(2/12,15/27)
95
106(7/14,28/44)
115(2/4,6,9,11/20,22)
121(p.25/74,107/124, 133/136)
124(p.19/70,85/101)
132(5/9)
137(p.26/63,84/85)

ASSEMBLY & TESTING

13(14/32)
33(16,20,22/26)
35(16/19,22/24)
39(10/14,39/43,56/63)
41(42/45,47)
43(16,28/55)
46(38/47)
48a(12/14,16,20/21, 38/45)
61(14,17,28)
62(7/12,20/21,31/32)
87(8)
76(50/58,63/64,78/84)
78(13/14)
94(12,29)
104(20/29)
113(7/10)
119(29/30,32,49)
121(p.75/79,103/106 125/132)
123(p.327/340,355/364, 395/402)
133(10/11,18D/E, 26-6/7,28-2/4, 29-11)
139(3)
32(26/28,33/35)
34(14,24/35)
38(11/12,56/63)
40(42/47)
42(31/50)
44(16/20)
48(6)
49(25/40)
60(11,15/16,22,29/30,39/40,42/43, 52/53,63/68,73/74,100/102)
63(14,49/55,90/92)
77(13/16,21/22)
87(4/5)
96
106(15/27,45/46)
115(5,7/8,10)
120(14,18,29,32,49)
122(p.75/79,40/42,49/50)
124(p.71/73,76/78,81/84)
132(10/11)
136(p.97/131)
137(p.64/83)

AUTOMATION

60(99)
61(27)
62(96)
63(34)
64(60,100/103,113)
65(23)
119(48)
120(48)
123(p.341/354)
124(p.74/75)

PACKAGING

133(19C/D, 29-4/5)

DISTRIBUTION

133(17D)

MARKETING

132(19)
133(18D/E,19B,19E, 25-5/7,29-2/3, 29-6/10)

Servicing was not included in the textbooks.

POWER & ENERGY

DC & AC	HOME WIRING	ELECTRONICS	COMMUNICATIONS	DIGITAL ELECTRONICS
16(A/B)	73(40)	16(C)	53(15/17)	5(11)
17	80(15/16)	51(1, 10)	76(97)	53(20)
46(48)	81(4/14)	53(1, 13/14)	77(31)	88(20)
50	82(5/14)	88(12/14)	80(18)	131(30/31)
51(2/4, 7/9)	83(5/14)	131(4/6, 27/29)	88(15/17)	
52	84(6/14)			
53(3/12, 19 19, 21)	85(4, 6/13, 15/16)			
54(7)	129(14)			
56(3)				
57(3)				
76(89/96)				
77(25/30)				
80(1/14, 19)				
81(1, 15)				
82(1/2, 4, 15)				
83(1, 4, 15)				
84(1, 4/5, 14/16)				
85(1, 5, 14)				
88(1/11, 19)				
125(2/5, 17)				
131(1/3, 7/26)				

INDUSTRIAL ELECTRONICS	HYDRAULICS & PNEUMATICS	ENERGY & FUEL	ALTERNATIVE ENERGY
51(12)	3(10)	51(5/6)	116(18/25)
53(18)	56(2)	53(2)	125(18/20, 25)
88(18)	57(2)	81(2/3)	
	116(26/27)	82(3)	
	123(p.463/472)	83(2/3)	
	124(p.102)	84(2/3)	
	125(26/27)	85(2/3)	
		116(17, 25, 28)	
		125(3, 23, 28)	

Computers were not covered in the textbooks.

CONSTRUCTION

GENERAL PRINCIPLES	HOME CONSTRUCTION	COMMERCIAL CONSTRUCTION
9(1/3, 9/24)	45(17, 51/56)	73(18)
40(52)	46(14)	
41(52)	46a(58)	
45(1/3, 18, 57/58)	72(2/15)	
46(1/2, 5)	73(7/9, 11/17, 19/21, 26)	
49(45)	76(88)	
69(11/13)	77(24)	
72(1, 16/19, 52)	129(3/13, 15)	
73(1/4, 22, 28)		
76(85)		
77(23)		
93(1/3)		
113(23)		
115(23)		
129(1/2, 17/18)		
130		

SITE PREPARATION	ROUGH CONSTRUCTION
45(19)	40(53/57, 60/62)
72(37, 51)	41(53/57)
73(5/6, 10, 38/39, 60)	45(4/16, 20/50)
	46(3/4, 6/13, 15/46)
	69(1/10)
	72(20/36, 38/50)
	73(23/25, 27, 29/37, 41/48)
	76(86/87)
	93(4/39)

Contracting, Interior Design, and Road and Bridge Construction were not covered in the textbooks.

TRANSPORTATION

HISTORY	AUTOMOTIVE SYSTEMS	AIRCRAFT
3(12)	3(1/9, 11)	76(103)
54(1, 11)	18(1/8, 12/34)	77(36)
57(1, 6)	19	116(12/16)
76(99, 101)	54(1/6, 8/19)	125(12/16)
77(32, 34)	55	
106(22)	56(1, 4/6)	
107(34)	57(4/5)	
112(34/35)	76(100, 105)	
116(1/6)	77(33, 38)	
125(1/2)	92	
128(8)	106(1/21)	
	107(1/33)	
	112(1/33)	
	116(7/11)	
	125(7/11, 21/22, 24)	
	128(1/7)	

WATERCRAFT	MASS TRANSPORTATION
76(104)	76(102)
77(37)	77(35)

Industrial Materials Handling and Nonfuel Vechiles were not covered in the textbooks.

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Listed in Alphabetical Order by Author
Major Cluster Emphasis in ( )

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Appendix C

Factor Analysis Results of the Questionnaire

on the Conceptual Characteristics of Industrial Arts

Appendix C

Characteristics of High School Industrial Arts

William Miller
Larry Hatch

Forward

Courses taught in industrial arts at the high school level do not bear standard titles or contain uniform content coverage. Nevertheless, the area of industrial arts is usually considered a subject area distinct from the sciences, mathematics, languages and social science courses taught at the high school level. In developing new curricular materials and in designing curriculum improvements it is obviously useful to understand what commonalities exist among a set of courses that are subsumed under the title "industrial arts". The Iowa Cadre for Improvement of Industrial Arts was formed to facilitate changes and improvements in Iowa industrial arts programs. In order to develop curriculum recommendations, develop and test curriculum materials and facilitate improvements in delivery of I. A. knowledge typically taught at the high school level, a preliminary study of high school industrial arts was initiated. One purpose of this study was to identify the major characteristics of high school industrial arts in Iowa and identify the common "dimensions" which exist among the various courses included in industrial arts. The specific study reported herein focuses on these commonalities. The purpose of this study was to identify traits of industrial arts courses that most industrial arts teachers feel characterize those courses and to identify underlying "themes" or dimensions of those traits.

Method

A random sample of 100 industrial arts teachers was selected from a list of high school I. A. teachers provided by the Department of Public Instruction. Each teacher selected was sent a questionnaire consisting

of 31 statements potentially characterizing high school industrial arts. The teachers were asked to indicate their degree of agreement on a 1 to 5 Likert scale. If they strongly agreed that most high school industrial arts courses included, involved, focused on, dealt with, required, considered, etc. a certain trait, they circled a value 5. If they strongly disagreed, they circled a value 1. Neither agreeing nor disagreeing (neutral) resulted in circling a 3, etc. A total of 70 teachers provided useable responses, yielding a return rate of 70 %.

A data file of response values to the 31 items of the questionnaire for the 70 teachers was created on a TRS-80 microcomputer. Using the Educational Statistics Programs (Miller, 1979), means and standard deviations of each item were calculated. In addition, a partial image factor analysis with a varimax rotation (Guttman, 1953) was performed. The items describing high school industrial arts traits were rank ordered according to the mean item response. Seven factors with eigenvalues greater than 1.0 were summarized by listing the items which correlate (load) with those factors to the highest degree.

Results

Figure 1 presents the results of the factor analysis and varimax rotation of the 31 items potentially characterizing courses in high school industrial arts. Factor I appears to be a reflection of course topics and activities designed to broadly develop the habits, values and interpersonal skills of students regarding the world of work. Factor II correlates with items predominantly describing the processing of materials and relates highly to the content emphasis of industrial arts as indicated by the mean ratings for those items (see figure 2). Factor III is a single-item factor dealing with recreational or avocational use of industrial arts. Factor IV is labeled "psychomotor skills" and represents

topics related to teaching manual skills. Factor V correlates with items more closely related to the general area of technology. Factor VI is also a single-item factor measuring the relative emphasis on learning skills rather than concepts. Factor VII correlated with two items that, by inspection, appear to be unrelated. For that reason, no name has been assigned to Factor VII. Since the factor analysis was based on such a small sample (N=59) of questionnaire forms on which all items were rated, the results must be considered descriptive in nature. No statistical tests for the factor loadings were conducted due to the small sample size.

Figure 2 presents the items in rank order of their mean ratings. Only the stimulus portion of the item is presented in order to emphasize the trait being evaluated. The top-ranked items indicate that teachers view industrial arts courses as emphasizing machine and material operations. Technology related and personal development topics received lower ratings thus indicating the teachers felt these traits or topics were less likely to be included in industrial arts.

Discussion

Teachers were asked to describe, by means of a Likert scale, the degree to which they agreed that certain topics would be included in industrial arts courses at the high school level. They were not asked what should be emphasized but rather what their perception was of what I. A. courses currently emphasize. At least 27 of the 31 topics reviewed by the teachers were rated above 3.5 on the average. This implies most teachers viewed nearly all of the items to be included in industrial arts to some degree. Those professionals who feel that industrial arts should include more technological emphasis and the integration of industry and technology concepts with business, home and

recreation will be disappointed. Teachers did not see industrial arts as currently providing much emphasis in those directions.

Six factors or "dimensions" of industrial arts courses were identified. These dimensions were tentatively labeled

1. Personal Development
2. Materials Processing
3. Avocational Uses
4. Psychomotor skills
5. Technology
6. Concepts versus skills

Potentially, each course taught in industrial arts at the high school level could be described by the degree to which the course reflects an emphasis in each dimension listed above. It should be noted that little evidence is provided to substantiate the current cluster of "Manufacturing", "Power and Energy" and "Graphics Communications" as being distinct, conceptual groups. It should also be noted that the item means for each factor above are respectively 3.84, 4.26, 3.64, 4.55, 3.74, 3.61, 3.99. Materials Processing, and Psychomotor Skills are the two highest (most commonly observed) dimensions of all industrial arts courses.

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Figure 2. Items Characterizing High School Industrial Arts in Rank Order from High to Low

(5 = strongly agree, 1 = strongly disagree)

RANK	ITEM NO.	ITEM STIMULUS	MEAN	STD. DEV.
1	13	safety	4.64	.69
2	22	example and demonstration	4.63	.52
3	2	skills	4.46	.63
4	14	work attitudes	4.36	.92
5.5	9	materials	4.22	.78
5.5	16	finishing	4.22	.70
7	10	combining	4.20	.76
8	31	body of knowledge	4.15	.71
10	11	cost estimation	4.14	.88
10	19	machines	4.14	.71
10	30	self worth	4.14	.75
12	6	terminology	4.10	.74
13	29	problem solving	4.08	.75
14	21	creativity	4.03	.79
15.5	7	career awareness	4.00	.83
15.5	20	pre-vocational	4.00	.85
17	1	processes	3.90	1.11
18	15	aesthetics	3.86	.88
19.5	12	organization	3.83	.81
19.5	3	manufacturing products	3.83	1.09
21.5	23	integrate subjects	3.80	.87
21.5	27	conservation	3.80	1.01
23.5	4	energy	3.64	1.01
23.5	26	recreation	3.64	.83
25.5	24	skill learning	3.61	.87
25.5	28	human relations	3.61	.95
27	5	systems	3.53	1.02
28.5	8	graphics	3.47	.97
28.5	18	technology	3.47	.97
30	25	changes in technology	3.44	.84
31	17	inter-relationships	3.29	.95

Figure 1. Partial Image Factor Analysis Results (N=)

FACTOR I: General Education for Personal Development (20.1%)

RANK	ITEM		LOADING
6	5.	Utilize systems concepts	.66
13	7.	Include vocational career awareness topics	.44
11	8.	Involve skill and understandings in using graphics media	
9	12.	Cover organization of personnel for work activities	.55
12	14.	Emphasis development of desirable work attitudes	.45
4	15.	Include instruction concerning aesthetics of Form, etc.	.71
10	17.	Examine the inter-relationships of business, industry, labor, etc.	.53
14	20.	Provide pre-vocational skills development	.37
7	21.	Focus on development of individual creativity	.61
5	23.	Integrate science, language and math with productivity	.68
8	27.	Stress conservation of energy, raw materials and resources	.57
3	28.	Emphasize interpersonal and human relations skills	.73
1	29.	Attempt to develop the students problem solving skills	.86
2	30.	Include emphasis on improving the students self-worth	.79

FACTOR II: Materials Processing (13.9%)

6	6.	Develop the use of industrial terminology	-.52
1	9.	Require acquisition of knowledge concerning materials	- 86
2	10.	Deal with combining materials or objects	-.82
3	11.	Include cost estimation for materials, construction,etc	-.77
4	13.	Stress safety in use of machines, materials, energy	-.63
5	16.	Consider methods and skills in the finishing or products	-.57

FACTOR III: Avocational Uses (5.7%)

1	26.	Provide for the learning of recreational skills	.75

FACTOR IV: Psychomotor Skills (5.4%)

RANK	ITEM	LOADING
2	2. Emphasize development of manual skills	.51
1	22. Utilize instruction by example and demonstration	.80

FACTOR V: Technology (13.0%)

2	1. Involve instruction concerning industrial processes	.79
1	3. Deal with manufacturing or repair of products	.82
6	4. Focus on one or more kinds of energy	.50
5	18. Provide instruction concerning technology and its impact	.54
3	25. Include instruction concerning changes in work, industry or technology	.63
4	19. Emphasize the use of machines in technology and production	.60

FACTOR VI: Concepts vs Skills (4.5%)

1	24. Stress activity and skill learning over concept mastery	.83

FACTOR VII: (unnamed) (4.5%)

2	12. Cover organization of personnel for work activities	-.58
1	31. Have an identified body of knowledge that is taught	.63

Appendix D

Questionnaire and Results of a Survey of

Course Units Taught in Iowa High School

Industrial Arts

Course Unit Description Form

Directions: Please supply the information requested below to the best of your knowledge. We have not defined the term unit. We prefer you to use your own definition in describing the sequence of activities or grouping of content in your course. You may wish to attach a course outline if it would add further clarification to what is in your course. Place the completed forms and materials in the self-addressed envelope and return.

1. School: _____ Teacher: _____ (first name,) (last name)
2. Title of course being described: _____
3. Number of semesters in length _____ Grades offered: 9, 10, 11, 12 (circle one or more)
4. Prerequisite courses(s) _____
5. This course is a prerequisite to: _____
6. Number of hours scheduled per week: _____
7. Number of: males currently enrolled _____ females enrolled _____
8. Number of handicapped students enrolled _____
9. Typical shop fee and/or materials cost per student $_____
10. Square feet of laboratory space used by this course: _____
11. Major equipment utilized in the course: _____,
    _____, _____, _____, _____, _____,
    _____, _____, _____, _____, _____,
12. Are lectures held in the laboratory? _____yes _____no
13. Are other courses taught in the same laboratory space?
    _____no _____yes, they are _____
14. Text books used: _____
15. Are handouts a major part of this course? Yes, No (Circle one)
16. Are the handouts teacher generated or purchased? (circle one or both)
17. Are films or other media used? Yes No (circle one)
18. Can you list the films or media used?

    _____
    _____
    _____
    _____

19. Units taught in this course are:

	Title or Description of Unit taught	No. of class hours in unit	% of time in lecture	Project required (Y/N)?	Test Given (Y/N)?
a.					
b.					
c.					
d.					
e.					
f.					
g.					
h.					
i.					
j.					
k.					
l.					
m.					
n.					
o.					
p.					
q.					
r.					
s.					
t.					
u.					
v.					
w.					
x.					
y.					
z.					

OBSERVED CONTENT AREAS
IOWA

I. COMMUNICATIONS
   A. DRAFTING
   B. ARCHITECTURAL DRAFTING
   C. GRAPHIC ARTS

II. POWER AND ENERGY
   A. SMALL ENGINES
   B. AUTOMECHANICS
   C. ELECTRICITY
   D. ELECTRONICS

III. PRODUCTION
   A. WOODS
   B. METALS
   C. WELDING
   D. PLASTICS

IOWA COURSE TITLES

COMMUNICATIONS

DRAFTING
DRAWING
MACHINE DRAFTING 1 2 3 4 5 6
DRAFTING TECHNOLOGY
TECHNICAL DRAFTING
RESIDENTIAL MODEL CONSTRUCTION
ARCHITECTURAL DRAFTING 1 2 3 4 5 6
GRAPHIC ARTS
GRAPHIC COMMUNICATIONS
INDUSTRIAL DRAWING
MECHANICAL DRAFTING

IOWA COURSE TITLES

PRODUCTION-MATERIALS AND PROCESSES

METALS MACHINING
HOT METALS
BASIC METALS
GENERAL METALS
METALS 1,2
GENERAL SHOP METALS
METALWORKING
MACHINE METALS
BENCH METALS
MACHINE SHOP 1,2

WELDING AND SHEET METAL
WELDING 1 2

WOODS
BEGINNING WOODWORKING
ADVANCED WOODWORKING
BEGINNING WOODS
ADVANCED WOODS
WOODWORKING I
WOOD TECHNOLOGY
PRINCIPLES IN WOODWORKING
CONSTRUCTION TECHNOLOGY

PLASTICS

IOWA COURSE TITLES

TRANSPORTATION-POWER AND ENERGY

POWER AND ENERGY
POWER SHOP
BEGINNING POWER
SMALL ENGINES

AUTO 1 2
AUTOMOTIVE MECHANICS
AUTOMOTIVE TESTING AND DIAGNOSIS
AUTOMOTIVE ENGINES
AUTOBODY
BODY AND FENDER

VOCATIONAL MECHANICS
VOCATIONAL AUTO
APPLIED ELECTRICITY
BASIC ELECTRICITY
ELECTRICITY ELECTRONICS
ELECTRICITY
ELECTRONICS 1 2 3 4 5 6

DRAFTING MASTER

MODULE

LETTERING
EQUIPMENT
BASIC PROCEDURES
PICTORIAL DRAWINGS
ORTHOGRAPHIC DRAWINGS
FITTINGS
TOLERANCES
SECTIONS
AUXILLIARIES
THREADS
FASTNERS
METRIC
WELDS
GEOMETRIC CONSTRUCTION
SHEETMETAL
ELECTRICAL
SHAPE DESCRIPTION
SURFACE GENERATION
WOOD CONSTRUCTION
SCALE READING
ALPHABET OF LINES
BLUEPRINT READING
PRINT REPRODUCTION
TANGENCY
SYMMETRY
ISOMETRICS
DIMENSIONING
FREEHAND SKETCHING
OBLIQUES
PERSPECTIVES
DESCRIPTIVE GEOMETRY
ASSEMBLY DRAWING
REVOLUTIONS
ELECTRONICS
GEARS
PRESENTATION DWG
COMPUTER GRAPHICS
MAPS AND SURVEYING
WELDING
MANUFACTURING PROCESSES
TECHNICAL ILLUSTRATING
GRAPHS AND CHARTS

ARCHITECTURAL DRAFTING

MASTER MODULES

INTRODUCTION
FLOOR PLANS
ROOM PLANS
HOUSE PLANS
FOUNDATIONS
ROOFS
STAIRS
FIREPLACES
WINDOW/DOORS
WIRING
ESTIMATING COSTS
ELEVATIONS
FOOTING
FLOOR CONSTRUCTION
PLUMBING PLAN
PLOT PLANS
DRAWING INSTRUMENTS
FIREPLACES/CHIMNEYS
HEATING/COOLING
SPECIFICATIONS
MODELS/
RENDERINGS
EXTERIOR DESIGN
BATHROOM DESIGN
KITCHEN DESIGN
PERSPECTIVES
SOLAR ENERGY

GRAPHIC ARTS MASTER

SPITIT MASTER
LETTERHEAD
SILKSCREEN
PHOTOGRAPHY
PAD PRESS
DEV FILM
DEV PRINTS
PHOTO SILKSCREEN
LETTERPRESS
BINDING
OFFSET PRESS
ENVELOPE

SMALL ENGINES MASTER

MODULE

GENERAL INFORMATION
OPERATING PRINCIPLES
ENGINE CONSTRUCTION
USE OF MANUAL
DISASSEMBLY CHECKS
MEASURING INSTRUMENTS
IGNITION
CARBORATION
GOVENOR CONTROL
CARBURETOR LINKAGE
GOVERNORS
COMPRESSION
STARTERS
LUBRICATION
PISTON RINGS,RODS
CRANKSHAFTS
CAM GEARS
CYLINDERS
BEARINGS
TOOLS
STARTER REPAIR
SERVICE OPERATIONS
CARE AND OPERATION

BASIC ELECTRICITY MASTER

MODULE

ELECTRON THEORY
CIRCUITS
SYMBOLS/CODES
COMPONENTS
SAFEY
E,I AND P
WIRES
RESISTANCE
OHM'S LAW
CIRCUITS(S&P)
MEASURING
TEST INSTRUMENTS
CAPACITANCE
CIRCUIT ANALYSIS
MAGNETISM
ELECTRO MAG
INDUCTANCE
CELLS AND BATTERIES
PRODUCING ELECTRICITY
GENERATORS
ELECTRONICS
WIRING DEVICES
SOLDERING
LIGHTING
HOME WIRING
ELEC MOTORS
HEAT
AUTO ELEC
HEAT
AUTO ELEC
TELEPHONE
AUDIO

ELECTRONICS MASTER

MODULES

CODES
BASIC METERS
TEST INSTRUMENTS
POWER SUPPLIES
TRACING CIRCUITS
SCHEMATICS
AUDIO AND RF GEN
OSCILLOSCOPES
SIGNAL TRACER
SIGNAL INJECTOR
TUBE AND TRANSITOR TESTER
CAPACITOR TESTER
VOLTMETER,AMMETER,OHMMETER
TROUBLESHOOT
CONTROLS, SENSORS
CAREER OPPORTUNITIES
TELEVISION REPAIR
AUDIO H.F.
DIGITAL
MICROPROCESSOR
COMPUTER FUNDAMENTALS
MIROCOMPUTER

AUTOMECHANICS MASTER

MODULE

SAFETY
TOOLS
REFERENCE MAT'LS
PARTS IDENTIFICATION
AUTOLUBE
INSPECTION
COOLING SYSTEM
ELECTRICAL SYSTEMS
BATTERIES
IGNITION
FUEL SYSTEMS
ENGINES
TUNEUPS
BRAKES
TIRES AND SUSPENSION
POWER TRAIN
TRANSMISSIONS
CLUTCHES
REAR END

WOODS TECHNOLOGY

MODULE

SAFETY
PLANNING AND DRAWING
WOOD SELECTION
WOOD INDENTIFICATION
ROUGH CUTTING
PLANING
SQUARING
DRILLING AND BORING
JOINTS
GLUEING AND CLAMPING
SHAPES, CHAMFHERS, BEVELS
METAL FASTNERS
FINISHING
STAINS
FILLERS
VARNISH
OIL FINISH
LACQUERS
ABRASIVES
CONSTRUCTION
JOINTER
TABLE SAW
BAND SAW
LATHE
RADIAL ARM SAW

PLASTICS MASTER

MODULE

SAFETY
PLASTICS INDUSTRY
POLYMER STRUCTURE
SHEET FABRICATION
THERMOLPLASTICS
THERMOSETS
THERMOFORMING
CASTING PROCESSES
PLASTISOL MOLDING
POWDER MOLDING
ROTATIONAL MOLDNG
BLOW MOLDING
FOAM MOLDING
INJECTION MOLDING
EXTRUSION MOLDING
REINFORCED PLASTIC
COMPRESSION MOLDING
CALANDERING
LAMINATION
DECORATION AND FINISHING
BUFFING PLASTICS
LIQUID CASTING

METALS TECHNOLOGY

MODULE

METALURGY/METALS AND USES
UNDERSTANDING DRAWINGS
MEASUREMENT AND LAYOUT
PRECISION MEASUREMENT/MICROMETER
METRICS
METAL SPINNING
ORNAMENTAL METALS
BENCH METAL
HANDTOOLS
DRILLING
THREADS AND FASTNERS
HEAT TREATING
CLAMPING DEVICES
METAL FINISHING
FOUNDRY
FORGING
MASS PRODUCTION
CAREERS IN METALS
METAL LATHE
FACING
TURNING
VERTICAL MILL
POWER SAWING
GRINDING
DRILL PRESS
TAPS AND DIES
TOOL BIT GRINDING
ELECTRIC WELDING
MIG
TIG
OXYACT WELDING/CUTTING
BRAZING
NON FERROUS METALS

CONSTRUCTION MASTER

MODULE

EQUIPMENT USE
BUILDING SITE DEV
SAFETY
BUILDING MATERIALS
PLAN. SPEC. CODES
FOOTING FOUNDATIONS
FRAMING
FLOOR
WALLS AND CEILINGS
ROOFS
WINDOWS/DOORS
WALLS
INSULATION
CEILINGS
STAIRS
DOORS AND TRIM
CABINETMAKING
CHIMNEY AND FIREPLACES
PREFAB
SCAFFOLDS AND LADDERS
CAREERS

WELDING

MODULE

SAFETY
MIG
TIG
ARC-STICK PROCESSES
BEADS
  FLAT
  WEAVE
  PAD
JOINTS
  FLAT BUTT
  FLAT LAP
  FLAT T-FILLET
  CORNER
HORIZONTAL BEADS
VERTICAL BEADS
OVERHEAD BEADS
  OUT OF POSITION
PIPE WELDING
READING WELD SYMBOLS
TESTING WELDS
OXY ACT
  WELDING
  BRAZING
  CUTTING
DRILLING
CARBON ARC
CAST IRON NICKEL ROD
LOW HYDROGEN
METALLERGY
JOINT DESIGN
SETTING UP OPERATIONS

Appendix E

Survey Instrument for Assessing the Priorities of Clusters and Topics for High School Industrial Arts.

Appendix E

Iowa State University of Science and Technology Ames, Iowa 50011

College of Education
Industrial Education
Telephone 515-294-1011

Priorities for Instruction in Secondary Industrial Arts
Iowa Cadre Project for Improvement
in Secondary Industrial Arts, Phase I
William G. Miller
Iowa State University

Industrial arts instruction in the secondary schools provides students the opportunity to develop a basic understanding of industry and technology including career opportunities, organization of industry, tools and materials of industry and skill development in industrial processes. Historically, there has been an emphasis on drafting, woodworking, metalworking and automechanics. Because technology and industrial practices have changed drastically in the past twenty years and because employment patterns have changed extensively, there is a need to reevaluate the secondary industrial arts curriculum. Leaders in the field have stated:

> "Industrial arts is at a critical point at which decisions must be made and made logically. Decisions should spring from a firm knowledge base while keeping the future in mind. And, they must be made soon." (Lemon 1981)

> "The complexities of industry and the changes in technology are developing at an unprecedented accelerating pace. Should not our curriculum and instruction follow suit and be as dynamic and exciting as the field that we are teaching?" (Bensen 1981)

You have been selected as an individual whose experience and knowledge will be highly valued in assisting this project to establish appropriate priorities for instruction of all secondary students in topics of industry and technology. We would appreciate your taking a few moments to complete this questionnaire and return it in the self-addressed envelope provided.

Thank you for your assistance.

William G. Miller

Dr. William G. Miller, Project Director
Department of Industrial Education
Iowa State University

Directions-Part I: In the attached documentation is a diagram of major groups of knowledge potentially included in industrial arts instruction at the secondary school level. You are asked to indicate how important each of the major clusters of topics is as an area of instruction to offer at the high school level. Make your evaluation by placing a check (X) on the line for each cluster at that point which indicates the importance you attach to that area. If you are unfamiliar with the topics or clusters presented on the opposite page, you may read additional descriptive information on the pages attached to this questionnaire. Please go ahead.

I. GRAPHIC COMMUNICATIONS

|_____|

Very Unimportant Moderately Important Highly Important

II. MANUFACTURING

|_____|

Very Unimportant Moderately Important Highly Important

III. POWER AND ENERGY

|_____|

Very Unimportant Moderately Important Highly Important

IV. CONSTRUCTION

|_____|

Very Unimportant Moderately Important Highly Important

V. TRANSPORTATION

|_____|

Very Unimportant Moderately Important Highly Important

Directions-Part II. For each of the five clusters just evaluated, there are a number of major topics which may be included in that cluster of instruction. Some topics should perhaps receive more emphasis (instructional time) than others. Please indicate, for each cluster topic, the relative importance of that topic within that cluster.

		[illegible] importance	[illegible] importance	[illegible] importance	[illegible] importance	[illegible] importance
I.	GRAPHIC COMMUNICATIONS TOPICS	1	2	3	4	5
a.	The nature and history of communications					
b.	Methods of printing					
c.	Photographic methods					
d.	Radio and television Production					
e.	Design principles					
f.	Mechanical drawing and drafting					
g.	Architectural drawing and drafting					
h.	Circuit design and drafting					
i.	Computer graphics, design, communications					
II.	MANUFACTURING TOPICS	1	2	3	4	5
a.	Purposes and organization of industry					
b.	Product research and development					
c.	Production planning and scheduling					
d.	Acquisition and inventory of raw materials					
e.	Materials processing, machining					
f.	Product assembly and testing					
g.	Automated manufacturing					
h.	Product packaging					
i.	Distribution and warehousing					
j.	Product marketing					
k.	Product servicing					

III. POWER AND ENERGY TOPICS	1	2	3	4	5
a. Principles of DC and AC					
b. Home service wiring					
c. Principles of electronics					
d. Communications applications					
e. Digital electronics					
f. Computer technology					
g. Industrial electronics					
i. Hydraulics and pneumatics					
j. Basic energy and fuel sources					
k. Alternate energy sources and systems					

IV. CONSTRUCTION TOPICS	1	2	3	4	5
a. General principles of construction					
b. Characteristics of home construction					
c. Construction of commercial property					
d. Contracting and subcontracting					
e. Preparation of the building site					
f. Framing and rough construction					
g. Interior design concepts					
i. Road and bridge construction					

IV. TRANSPORTATION TOPICS	1	2	3	4	5
a. History and nature of transportation					
b. Automotive systems					
c. Aircraft					
d. Watercraft					
f. Mass transportation systems					
g. Industrial materials handling					
h. Non-fuel vehicles and transportation systems					

THANK YOU FOR YOUR ASSISTANCE. PLEASE PLACE THIS QUESTIONNAIRE IN THE RETURN ENVELOPE AND MAIL TODAY.

Graphic Communications	Manufacturing	Power and Energy	Construction	Transportation
a. History	a. Purposes and Organization	a. DC and AC	a. General Principles	a. History
b. Printing	b. Research and Development	b. Home Wiring	b. Home Construction	b. Automotive Systems
c. Photography	c. Planning and Scheduling	c. Electronics	c. Commercial Const.	c. Aircraft
d. Radio and TV	d. Acquisitions Inventory	d. Communications	d. Contracting	d. Watercraft
e. Design	e. Processing and Machining	e. Digital electronics	e. Site Preparation	e. Mass Transportation
f. Mechanical Draft	f. Assembly and Testing	f. Computers	f. Rough Construction	f. Industrial Materials Handling
g. Architectual Draft	g. Automation	g. Industrial Electr.	g. Interior Design	g. Non-fuel Vehicles
h. circuit Design	h. Packaging	h. Hydraulics	h. Road and Bridge	
i. Computer Graphics	i. Distribution	i. Energy and Fuels		
	j. Marketing	j. Alternative Energy		
	k. Servicing			

[redacted]

[illegible]

11. Manufacturing

a. Purposes and Organization of Industry. Historical changes in organization of labor, manufacturing and marketing are described. Characteristics of investments, costs, and profits are discussed. Roles of investors, owners, managers, marketing personnel, Research and Development personnel, production personnel, distribution personnel, safety and maintenance personnel, and service personnel are presented. Federal and state laws concerning investment, regulation and taxation are covered.

b. Product Research and Development. Procedures employed to imagine, evaluate the feasibility, develop methods to produce, and prototype a new product are examined. Experiences in organizing and coordinating personnel to complete an R and D project are provided.

c. Production Planning and Scheduling. Use of Critical Path Methods (CPM), Program Evaluation and Review Technique (PERT) or other methods of planning and scheduling of purchases, processing, hiring, etc. in industry are demonstrated. Cost estimation, tooling time estimation, estimating the time required for machining and fabrication, time estimation for testing, packaging, warehousing, distribution, etc. are performed. Simulated or actual pilot production lines are constructed to provide experience in production planning, scheduling and control.

d. Acquisition and Inventory of Raw Materials. Sources, both foreign and domestic, for supply of raw or partially finished materials for use in manufacturing are investigated. Methods of classifying, cataloging, ordering, receiving, inventory and storing of basic materials are described. Materials, personnel, and facilities costs for acquisition are described. Experiences in acquiring materials for a simulated or pilot production operation are provided.

e. Materials Processing, Machining. Methods for transforming raw materials through the application of technology and scientific principles are demonstrated. Included are pounding, drawing, melting, chiping, and grinding operations performed in casting, milling, lathe turning, metal extrusion and welding operations. Metals, plastics, glass, ceramic, wood and fiber materials are processed. Basic machine usage and safety aspects are demonstrated.

f. Product Assembly and Testing. Methods of fastening and assembly are covered including welding, adhesives, mechanical joining, screws and bolts, rivets, etc. Finishing materials and methods are demonstrated. Product torture-testing, representative operations testing, tolerance measuring, material testing, etc. to assure quality and performance standards are covered.

g. Automated Manufacturing. Numerical control equipment, robots, computer aided manufacturing, and assembly line operations are described and demonstrated. Implications for personnel training, recruitment and retention are examined. Investment and operations costs are described.

h. Product Packaging. Materials, design, methods, costs and characteristics of product packaging are demonstrated. Products designed and manufactured in a simulation or pilot plant are packaged for sale and distribution.

i. Distribution and Warehousing. Computer techniques for product inventory, storage, routing and delivery; costs for alternative transportation systems, security systems and insurance programs for stored materials, overseas shipping regulations and markets, maximizing order delivery response, etc. are discussed within this unit.

j. Product Marketing. Methods and costs for advertising, advance advertising, securing of orders, recruitment and hiring of sales personnel, commission and salary plans for sales personnel, systems support of ordering, delivery, billing and receipts are topics covered in this unit. k. Product Servicing. Service organization, personnel requirements, service costing, inventory of parts, utilization of service records, equipment warranties, utilization of independent service companies and costs associated with servicing are all examined in this unit.

III. Power and Energy

a. Principles of Direct Current and Alternating Current. This unit covers the physics of electrons, conductors, resistors, semiconductors, inductors and capacitors. Industrial and domestic service wiring is discussed and demonstrated. Principles of DC and AC motors are covered.

b. Home Service Wiring. This unit covers the specification, installation and operation of 110/220 volt domestic electrical service. Use of the watt meter, selection of energy efficient appliances, minimizing electrical consumption, repairing cords and plugs, use and interface to alternative energy sources and safety aspects are covered.

c. Principles of Electronics. This unit presents basic concepts related to power supplies, voltage and current transformations, amplification, voltage and current regulation, oscillators, choppers, current switching, audio and radio frequency transmission and propagation, and commercial applications.

d. Communications and Applications. Commercial AM and FM radio, TV, and telephone communications systems are described. Basic concepts of modulation, signal multiplexing, data encoding, detection, demodulation, demultiplexing and decoding are covered. Sideband transmission, filtering, signal repeating, noise suppression and safety aspects are also included.

Digital Electronics. Topics included in this unit include transistors, LSI circuits, printed circuits, pulse or square wave generators, binary number systems, flip-flops, gates, counters, digital filters, signal and component connection standards and analog-digital and digital-analog signal conversions. Applications in automotive control systems, home appliances, process control, communications and computers are discussed.

f. Computer Technology. This unit covers the basic organization and parts of computers, stored program concepts, systems analysis and flowcharting, machine language programming and high level interpretor and compilor languages. Applications in business and industry are demonstrated.
C g. Industrial Electronics. This unit covers use of DC for metal melting and refining, welding, depositon, and other industrial applications. Systems combining electrical, mechanical, and hydraulic or pnuematic components are described.

h. Hydraulics and Pnuematics. Basic components and operational characteristics of hydraulics and pnuematic systems are covered. Applications in agriculture, mining, manufacturing, and transportation industries are demonstrated.

i. Basic Energy and Fuel Sources. Sources of natural and artifical fuels, fuel costs, fuel transportation and distribution, units of measurement for energy and fuels, energy conservation, hybrid systems, solar collectors, social and legal implications of fuel shortages, and safety in handling fuels are some of the topics included in this unit.

j. Alternate Energy. This unit focuses on construction, installation and use of solar collectors, photovoltaic cells, wind generators, hydroelectric generators, biomass systems, atomic energy and other alternatives to fossil fuels. Operational systems are constructed and studied.

Appendix F

Trends in Work and Employment

Appendix F

WORK TRENDS

For the past fifty years industrial arts has been recognized as general education. The general education philosophy assumes that every student should acquire a knowledge of the methods society uses to produce the goods and services that it needs.

The means that society uses to produce the goods and services has changed from the self-sufficient family unit to a complex system of mass production. When the family was the basic manufacturing unit, each member had to acquire a variety of skills and knowledge to provide the spectrum of goods and services that the family unit consumed. In today's complex manufacturing system, the individual worker ordinarily performs a highly specialized job to provide goods and services to a large segment of society. It is entirely possible for a worker to spend his working life producing a minute portion of some product that he/she may never use directly.

A half century ago the work force was at some point between the ends of the "self-sufficient-specialization" scale. The industrial revolution was providing opportunities for the work force to move from a largely self-sufficient agrarian society into a more specialized industrial structure. The workers who were making this transition were mainly agricultural workers and newly arrived immigrants. These individuals quickly recognized that the system permitted upward mobility to higher paying, more satisfying positions. To gain these positions they educated themselves, thereby accelerating the change that was occurring in industry.

In the mean time the methods used by industry to produce goods and services were becoming so complex that a high degree of specialization became necessary. Census information dating from 1920 shows that mechanical, industrial, and aeronautical engineers were included as one heading. By 1930 industrial engineering had become a separate category and aeronautical engineers were listed separately by 1950. The introduction of new technologies created a need for new occupations and new technologies created a need for new occupations and specializations. Each time a new technology was introduced, the system employed more people who worked with information and fewer who worked with materials. Figure 1 traces the decline of the manual labor force and the growth in the professional segment that took place in the work force between 1920 and 1980.

Figure 2 depicts the composition of the work force in 1920 and 1970 in percentages of professional, agricultural, service, and manual workers.

In addition to becoming more professional, the nation's work force has also become much more service oriented. As the population moved from rural settings to industrial centers it became necessary for government to provide more services, such as fire and police protection. The urban population also required an extensive system to transport and distribute products from the point of manufacture to the consumer.

Another perspective of employment patterns can be gained by grouping workers according to industry. Figure 3 is based on 1978 statistics that show how manual, service, and professional workers are distributed by industry.

This figure shows that 30 percent of the work force is actively engaged in producing goods while 70 percent is associated with the delivery of services. Figure 3 also shows a division of the manufacturing portion

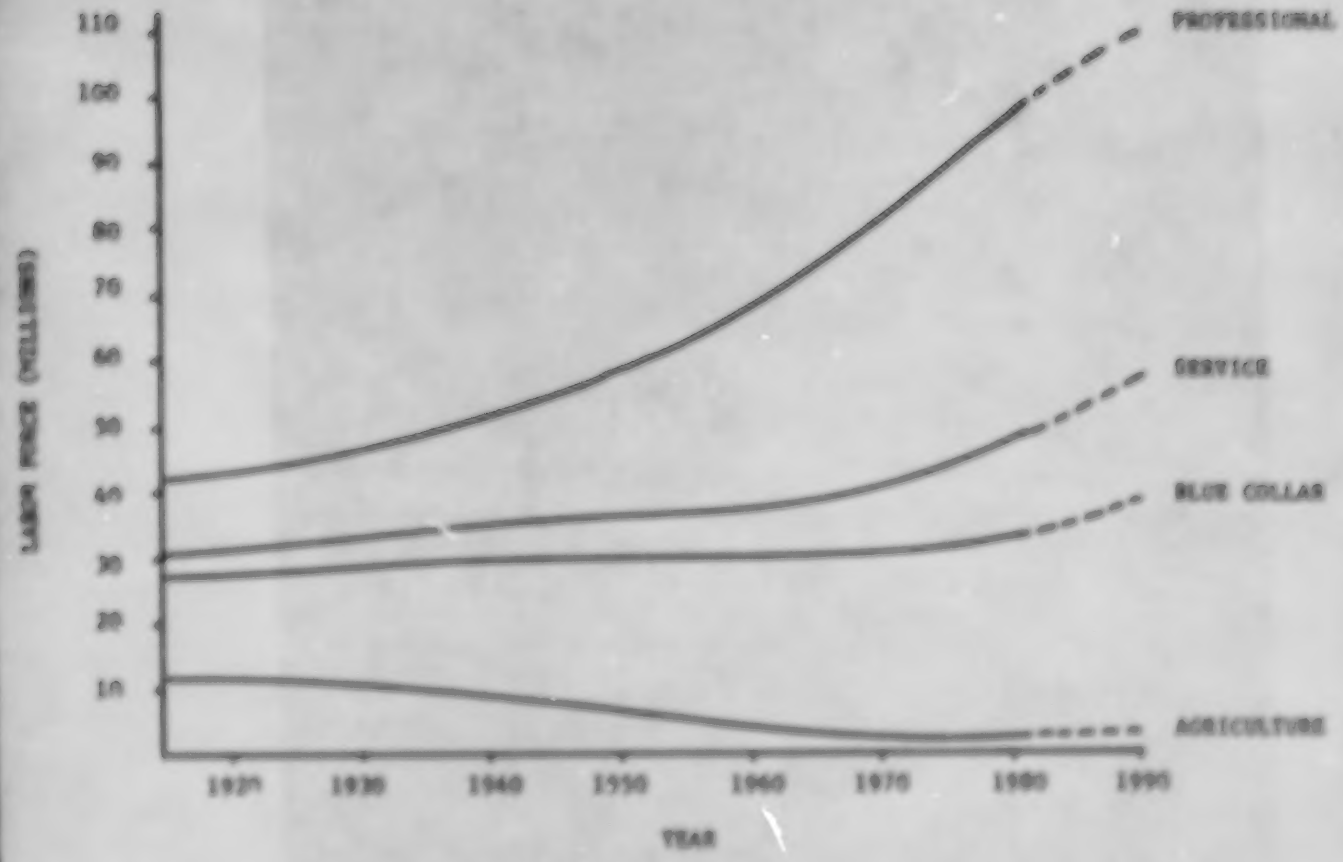

FIGURE 1

SOURCE: U.S. Bureau of the Census Historical Statistics of the United States, Colonial Times to 1970, Bicentennial Edition Part 2 Washington D.C., 1975

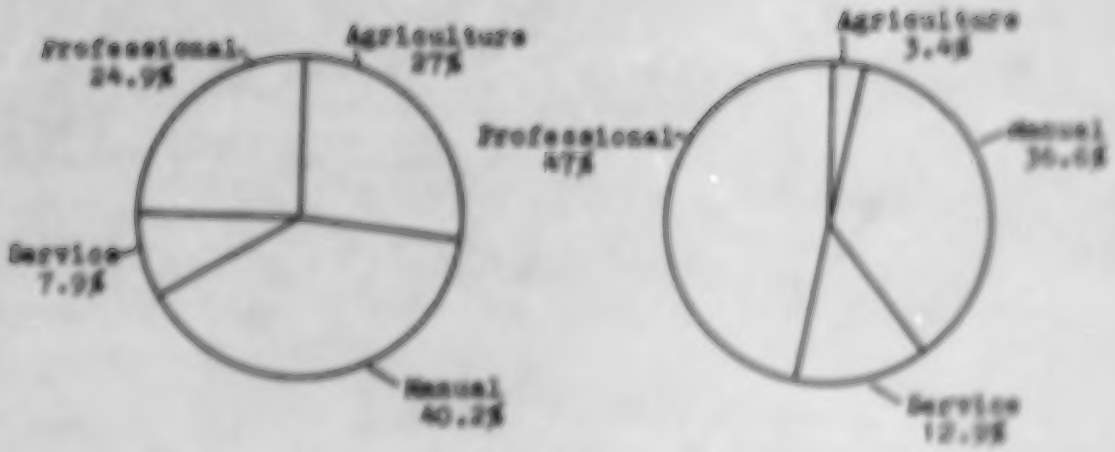

Figure 8

Source: Historical Statistics of the United States, Colonial Times to 1970, Bicentennial Edition Part 2. U.S. Bureau of the Census.

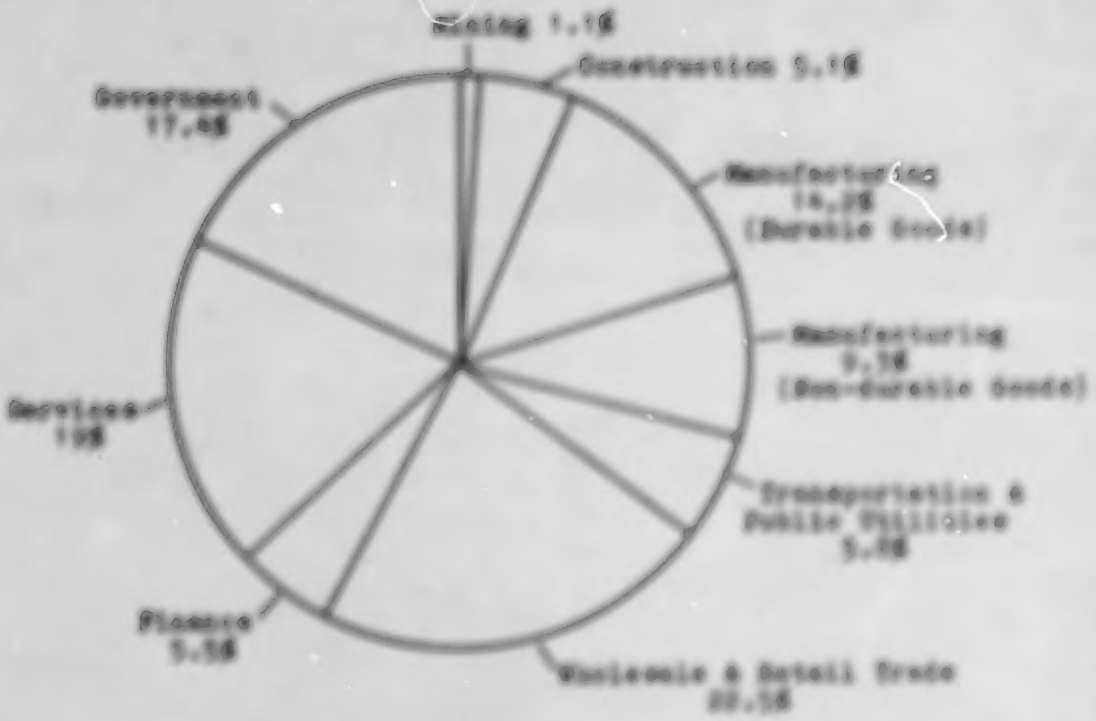

Figure 3

Source: Statistical abstract of the United States (101st edition). Washington D.C.: U.S. Bureau of the Census, 1980.

Portion of the Total Work Force
Currently Served by the Industrial Arts Curriculum

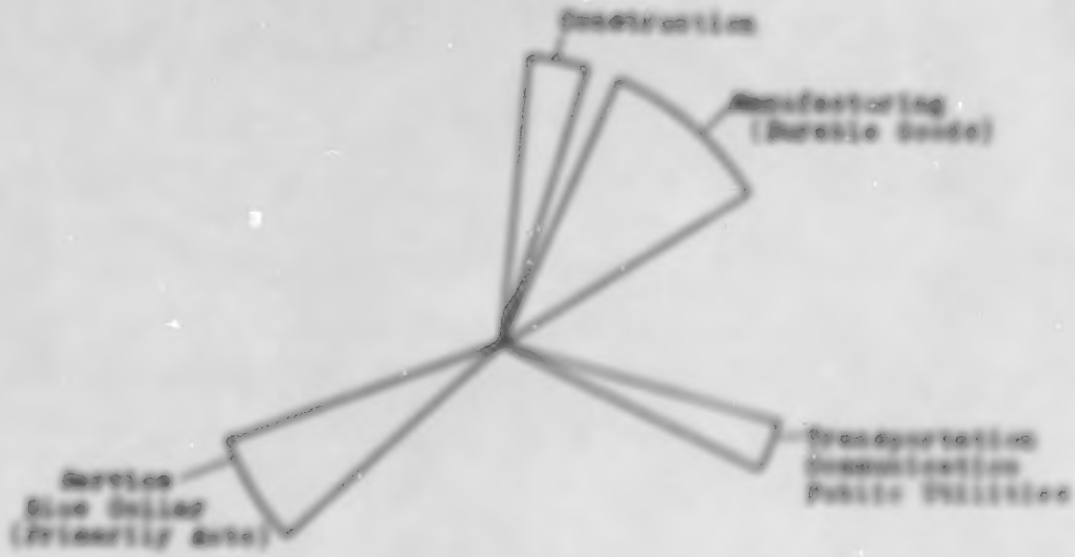

Figure 4

Source: Occupational Outlook Handbook, 1980-81 Edition, U.S. Department of Labor, Bulletin 2075. March, 1980.

of occupations into durable goods and nondurable goods. Durable goods manufacture involves the use of wood, metal, and plastic to produce machines, automobiles, appliances, etc. The nondurable goods include materials and processes associated with food, textiles, and paper.

The industrial arts curriculum is most closely associated with the manufacture of durable goods and construction with somewhat less emphasis placed on the communication and service industries. Figure 4 shows that the typical industrial arts curriculum focuses on less than half of the occupational content found in American industry.

When the professional occupations are subtracted from these occupational areas it appears that industrial arts courses are aimed at less than 15 percent of the total working population.

Fifty years ago there were very few people who were qualified to manage the technologies that were beginning to find application in industry. The greatest portion of the working force was needed to provide power at the manual level. The 1930 work force can be depicted graphically as a triangle with the base composed of manual labor used to provide power for moving materials. Small numbers of craftsmen, technicians, managers, and proprietors could be placed at successively smaller strata above the manual workers. The introduction of technology caused two changes to occur simultaneously. First, the new technologies called for the creation of professional positions to manage and control the new complex systems. Second, the new technologies reduced the need for muscle power. Those who had previously provided the muscle power either lost their jobs or were retrained as operatives to run the machines.

Today, a graphical representation of the work force would assume a globe shape with the center portion comprising the largest group of workers. The manual workers would comprise a relatively small base under a

largest group of technicians and managers. Proprietors would have the most gains at the top. The majority of today's workers nearly regardless skills rather than postsecondary skills to their jobs.

Forecasting future trends in the labor force is an inexact process at best. Revisions to the methods for reporting occupational data make it difficult to make exact comparisons from one time segment to another. The popular press contains numerous examples of contradictory forecasts regarding economic matters. Regardless of the dangers involved, industry needs a sizeable effort to produce accurate forecasts so that the appropriate productive facilities and materials will be in place when needed. The industrial arts curriculum planners also forecast future trends so that the appropriate educational courses and facilities will be in place when needed. The method frequently used to forecast future trends is to project current trends into the future. This method assumes that social and/or economic upheaval will not occur and dramatically change the trend that is existing.

The Dictionary of Occupational Titles contains 21,000 job listings that are commonly used to describe the country's work force. The 1970 edition lists 240 new occupations, which were not included in the previous edition; in addition, 500 titles were dropped. The combined additions and deletions represent more than one-fourth of the total listings. Some of this change may reflect changes in job titles while retaining essentially the same job content, but the number of changes does serve to illustrate that evolution is taking place in the labor force. The invention of the automobile greatly reduced the need for leather craft workers. Blacksmithing, except as a craft, has been severely replaced by automation. Occasionally a material has disappeared from use so productive jobs no longer exist or a higher share of technology

[illegible] a labor force. They used to assess workers for the production of [illegible] are replaced by global products. They measured as an economic [illegible] only to be replaced by cheaper products. Workers [illegible] products are not used as the most appropriate material to protect [illegible] workplace during re-work.

There is another evidence to suggest that the service's employment [illegible] will continue to change at an accelerated rate. The expansion of automation and the introduction of robotics will accelerate the changes that technology has already produced. The Japanese have introduced robotics into their manufacturing sector and [illegible] to the expected use. This increase [illegible] that only 3 percent of their manufacturing work force will be directly involved with processing materials by the turn of the century. Industry in the United States will increasingly emphasize high technology. This will reduce the need for unskilled labor.

According to [illegible] technologies will be [illegible] evolved, and become obsolete so quickly that new workers will find it necessary to make several career changes. These changes will occur in [illegible] levels, making it necessary for laborers [illegible] the educational system to receive multiple [illegible].

Workers as well as technology will influence the kinds, quantity, and levels of occupations that will be made available in the future job market. The Occupational Outlook, prepared by the Department of Labor, cites three population trends that will affect the number and types of future jobs. These trends include: population growth, population age [illegible], and population migration.

[illegible]

The population is expected to increase from [illegible] million by 1980 to [illegible] million by the year 2000. A population growth of this magnitude will result in an increased demand for all goods and services. The increased demand will in turn require additional workers. Therefore, all areas and levels of employment should experience some growth but the structure of the population will create special demand in selected areas.

[illegible]

The structure of the population affects the work force in two ways: as workers and as consumers. As workers, there are not to enough jobs to provide all of the population with the employment opportunities that they expect to be available. As consumers, a large age group creates increased demand for particular kinds of goods and services.

Family size was generally smaller during the depression decade of the 30's and the war years of the early 40's. The last half of the 1940's and the 1950's witnessed a sharp increase in the number of births. When the "baby boom" generation was ready to enter the labor market, the market was not able to provide enough jobs at the various skill levels for which the workers were prepared. This group also represents a large portion of the present consumer population and creates demands for particular kinds of goods and services. At the present time there is an increased demand for housing and durable goods which is the result of the large population that is buying and furnishing their first homes.

More people are living longer due primarily to improved health care. The older population also creates demand for certain categories of goods and services such as medical and pharmaceuticals.

[illegible]

A significant portion of the population is moving from the northeastern and northern states to the south and west. The population of the entire country grew at an annual rate of .8 percent between 1970 and 1975. The rate of growth for the northeast and north central states was .3 percent and .4 percent respectively during the same five year period. The population grew by 1.3 percent in the southern states and 1.6 percent in the western states. Of the count established during the early seventies centuses, more than half of the entire population will be located in the Sun Belt by 1985. (Occupational Outlook Handbook 1980-81, p. 10) Figure 1 shows the population census of the United States at the time of each census and the direction and magnitude of the population shift.

Jobs are also leaving the northeast and north central regions for the sunbelt citizens. A large number of the manufacturing industries usually associated with the northeast are moving to the south and west. Lower taxes, cheaper labor, and lower energy costs are usually given as the reasons for a company to relocate or choose the region for additional facilities. Individuals usually move to these regions seeking jobs and relief from high energy costs.

Light manufacturing involving products such as electronics parts and systems, textiles, and paper products are ordinarily associated with those companies that relocate to the Sun Belt. In addition to the jobs created by these industries, additional workers are also required to provide a magnitude of services required by a growing population such as police, fire protection, utilities, transportation, and construction.

The number and kinds of jobs that will be available in the 1980's

Appendix B

A Short Review of Contemporary

Industrial Area Programs

[illegible]

[illegible]

Industrial Arts Curriculum Project

Maryland Plan

Industrialology Project

[illegible]

The decade of the 1950's witnessed the introduction of more than 30 industrial arts curriculum innovations. The upsurge in curriculum activity was precipitated by two events: Sputnik in 1957 and the Vocational Act of 1963.

When Sputnik was placed in orbit by the Russians in 1957, the American public's concern turned to the country's educational system. The entire 9-12 curriculum came under close scrutiny for possible areas of improvement. Although public attention focused primarily on the math and science curriculums, the leadership in all subject areas began to question, review, revise and update course content. Extensive review of the subject matter areas by educators and expert lay people revealed that the entire secondary curriculum contained far too much material that had been outdated by technology. Much of this outdated material remained in the curriculum through tradition alone. New materials and programs covering the entire spectrum of the 9-12 curriculum were developed, field tested, and introduced in a concerted effort to bring the subject matter into closer association with what was happening in the real world.

The same problems which plague other subject matter areas were also prevalent in industrial arts. Leaders at the college, state, department, and school district levels began to devise programs for remedying the problems.

The Vocational Act of 1963 was heavily lauded and permitted the application of federal funds to industrial arts education. Federal money permitted curriculum studies of greater magnitude, depth, and length than had been possible previously. Individuals and groups concerned about industrial arts education began to revise the industrial arts curriculum to reflect the current state of industry, technology, and the industrial society.

[illegible] [illegible] [illegible]

In Idaho, the Industrial Arts Curriculum Project (IACP) represents the most comprehensive effort directed at developing a program of studies that influence modern industry. The project lasted for approximately five years, benefited leaders from the educational, industrial, and economic communities, and culminated in a two-year program directed at the junior high level. The IACP was widely accepted by industrial arts educators and has been implemented in numerous junior high schools across the United States as well as in several foreign countries. Later efforts were directed at developing similar programs for use at the senior high level. Initial work on the Construction Education Curriculum Project (CECP) and the Manufacturing Education Curriculum Project (MECP) was completed during the 1973-74 school year at Ohio State University. However, the funding necessary for completing the development and implementation of these programs could not be acquired. Although the IACP and the MECP programs have not been developed or tested, they still remain a promising intervention for industrial arts at the senior high level.

The rationale used to develop the IACP and the MECP programs are almost identical to that used to develop the IACP for the junior high schools. Both the junior and senior high programs represent an industrial model for industrial arts subject matter used to structure the scope and sequence of material taught.

The junior high school Industrial Arts Curriculum Project was initiated by a group of concerned educational leaders representing Ohio State University, the University of Illinois, and the Stanislaus Ohio Public Schools. These individuals recognized the need for a curriculum which would be representative of the activities carried on by modern

industry. Traditional industrial arts courses seemed to be a collection of unrelated hand crafts and skill courses focused primarily on tools and details. Although most industrial arts practitioners agreed with this assessment of the curriculum, they could not reach agreement upon what should constitute the industrial arts curriculum. Industrial arts included courses in woods and drafting as well as courses which enhance efficient details and power mechanics. The IAFF designers believe that industrial arts courses needed to be reoriented around industry in a manner similar to the way that science courses are reoriented around details. An innovative research and development effort was initiated to isolate and prioritize that segment of human knowledge that would be appropriate for inclusion in the industrial arts curriculum. The IAFF designs made the following assumptions about industrial arts.

1. Industrial arts is a study of industry. It is an essential part of the education of all students in order that they may better understand their industrial environment and make wise decisions affecting their occupational goals.
2. Man has lived and creative culture about industry, its materials, processes, organization, research, and services.
3. Industry is an open & evolving institution that it is necessary, for instructional purposes, to place an emphasis on conceptualizing a fundamental structure of the field, i.e., a system of basic principles, concepts, and unifying themes.

Further assumptions were made as the study progressed:

1. For purposes of analysis, man's knowledge can be categorized and ordered logically.
2. To provide for the most effective and efficient transmission

of knowledge, the educator should codify and enumerate discipline-based bodies of knowledge.

3. The structure of a body of knowledge can be developed before the total curriculum is designed.
4. All domains of man's knowledge must be included in an effective general educational program.

(Hawes, p. 13)

To enumerate the curriculum, the SAIP researchers adopted Blanchard Hawes's four types of theoretical knowledge as the model for enumerating man's knowledge. These include formal, descriptive, prescriptive, and praxeological knowledge. Formal knowledge is defined as the tools that man uses to enumerate and organize all other knowledge. Descriptive knowledge is used to see in fact and establish facts about events. The physical, biological, and social sciences are placed in this dimension of man's knowledge. Prescriptive knowledge places values on events and phenomena. The fine arts are included as prescriptive knowledge. The final dimension of man's knowledge is classified as praxiology. This knowledge is needed to practice a science, art, or occupation. Education, medical, and agricultural courses focus on this dimension of man's knowledge.

The SCIP researchers reasoned that the four dimensions of knowledge are applied within each of the competencies derived by Gen. These competencies are ordinarily divided into five categories: technical, artistic, educational, religious, and economic. Within the economic competencies are various principles of logic, mathematics, sciences, values, and technology.

Within the economic competencies, multiple activities may occur simultaneously. Material production, financing, legal services, marketing, transportation, and communication are but a few of the activities that must be carried on to insure the smooth functioning of the economic organization.

The material production activities carried on within the economic competency setting relate to the raw material as it passes from source to consumer. Genetic, generative, and behavioral are the three main divisions of material production activity.

Genetic and generative activities such as agriculture, breeding, and mining are relative to other educational disciplines and, therefore, are not included in the behavioral area curriculum. The knowledge used to carry on the behavioral activities was considered most appropriate for inclusion in the behavioral area curriculum. Manufacturing and construction were identified as the major activities carried on in behavioral production function.

The "World of Construction" evolved from the SCIP effort to provide a real world context. It was designed to give every student an opportunity to use and apply the knowledge and skills used in the construction of buildings, bridges, roads, etc. Each student participates in laboratory activities typically used in on-site construction. These activities might include surveying, brick laying, plastering, and carpentry.

[illegible] [illegible] [illegible] [

3. Producing and Servicing Physical-Mechanical Products
4. Consumer-Service Manufacturing Processes

Plotting for the scoring and percentile determinants and are shown on, therefore, the projects have not been pushed at the second high school level.

The Maryland Plan

The Maryland Plan for the elementary grade curriculum was developed through the efforts of Joseph Mills of the University of Maryland. Mills's plan was developed over a extensive span period from 1948 through 1967 without the use of loading.

The Maryland Plan was initially developed for use in the junior high level and eventually extended to include the fifth, sixth, and sixth grades. The Maryland Plan differs from other plans in that it offers the teacher greatest latitude in planning course activities. The activities, techniques, and psychological needs of the individual and of the class are considered when defining course content.

Five terms are used to define the general curriculum in the Maryland Plan. The anthropological unit stresses historical development of tools, power, communications, and technology. The research and exploration area gives students an opportunity to increase their depth of study of subjects. The life participation area expose the students to financing, advertising, and product distribution through role playing and decision making. The group process unit permits the study of a specific subject in depth.

The unit, overview, project, seminar process is used at the present grade level to study the development of tools, power, and communication transportation. Each student is encouraged to select and develop projects, reports, displays, etc. of his/her choice. The student is expected to use materials resources and experimentation to develop a concrete process and report his/her findings to the class.

Eighth grade students choose as subjects such as steel, paper-making, or plastics for in-depth study. They study the organization and management portion needed to operate their chosen industry and the

[illegible]

The [illegible] program of [illegible] was developed by [illegible] of [illegible] [illegible] [illegible] and [illegible] [illegible] [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

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Figure 5

Source: Statistical Abstract of the United States (101st Edition). Washington D.C.: U.S. Bureau of the Census, 1980.

and beyond will vary considerably from region to region. Those industries that tend to relocate are often more knowledge intensive and require more employees at the technical and managerial levels and fewer people who would be considered blue collar employees.

American companies are moving large numbers of labor intensive jobs to foreign countries. Cheaper labor costs and lower taxes are ordinarily cited as the reasons for this migration.

Women in the Labor Force

Another factor to be considered in the work force is the number of women seeking employment. World War II is considered as the decisive point when women entered the labor market. Manpower shortages brought about by the war required that women enter the labor market in large numbers to supplement the war efforts. In 1940, 25 percent of the female population was employed outside the home. By the end of the Second World War, six million women had taken jobs and comprised 36 percent of the work force. (W. Chafe) During the war they assumed most of the jobs previously held by men at almost all levels and positions.

After the war, women continued to enter the labor force despite traditionally held social values that prescribed that they choose between homemaking and career. Poor women were "allowed" to work if they were married and had small children, but it was considered to be a negative reflection on the husband for the middle class wife to take work outside the home.

Changing social attitudes, labor saving devices, processed foods, a trend toward fewer children, inflation, single parent households, and an interest in careers all served to attract large numbers of women into the labor force during the 1960's and 1970's. Two traits that are dis-

tinctly American must also be considered as reasons why women preferred to work outside of the home. First, success in this country is measured largely by economic standards and secondly, each family feels compelled to "keep up with the Joneses". Working wives and mothers permit the family to acquire many of the material goods that it would not otherwise be able to afford. And it is hard to keep up with the Jones' if the Jones' have two incomes.

The census data shows that the labor force was composed of 38 percent female workers in 1900 and that it increased to 43 percent by 1970. The trend seems to indicate that women, including wives and mothers of young children, are continuing to enter the work force in large numbers and that they are accepting jobs at all levels. The number of women completing college degrees in the past fifteen years has increased at a rate twice that for men. This is rapidly increasing the number of women available for professional level positions.

The literature reviewed for this report does not provide a clear indication as to whether or not this trend will continue. One school of thought maintains that the percentage of working women will continue at somewhere near the present level. Others feel that a tight job market will decrease the number of working women. Women have traditionally entered the labor force in large numbers during times of economic growth and inflation, but found it more difficult to find jobs during periods of economic recession.

Worker Involvement

Worker dissatisfaction is probably as old as work itself. The industrial community has become increasingly concerned with the problem because worker dissatisfaction can adversely affect the well-being of

the entire enterprise. Worker dissatisfaction can result in lower production, poor quality, high absenteeism, drug use on the job, and in some cases production sabotage.

When industry was dependent largely on unskilled labor to produce goods and services, job satisfaction was usually ignored by managers. Most employers felt that if workers were not satisfied with their jobs, they were simply free to leave and find positions elsewhere. When employees did leave, they were quickly replaced by workers who were easily trained.

Working people accepted the boredom, dirt, and danger that went with many jobs as part of the job. The Protestant work ethic dictated that each member of society must work hard and get ahead regardless of his position on the social ladder. In keeping with the work ethic, children were generally introduced to work at an early age. Farm children worked beside their parents and it was also socially acceptable for young children to work in the factories and mills of the industrial centers. Most workers were literally raised with the idea that work was not necessarily meant to be enjoyed. This perception of work gradually changed and many individuals expected more from their jobs than simply the means of providing the necessities of life. Younger workers, especially, changed jobs frequently in an effort to find more meaningful and satisfying jobs. These younger employees had not known depression and had become accustomed to the benefits provided by society. They seemed to be much more secure about changing jobs.

The introduction of technology and the necessity for a better trained work force made it much more costly to replace employees. Costs of hiring, training, lost production during training, and errors made by new employees were all considered direct costs associated with worker

replacement. Worker morale and increased work load for supervisors were considered to be indirect costs. Managers realized that labor was a valuable resource to the company and not just a cheap, easily replaced commodity. Tools and technology must have qualified people to make them useful to the company.

Management has generally found that blue collar worker complaints involve lack of respect from supervisors, rigid work hours, no allowance for worker incentives, safety protection procedures, and too much required overtime. White collar workers generally found their jobs uninteresting and not challenging enough for their qualifications. Management responded by offering longer vacations, 4 day work weeks, better working conditions, etc. for blue collar workers. These efforts have not been entirely successful in achieving worker satisfaction.

Japanese industry does not seem to be plagued by these problems. Their worker productivity is very high and their work force is generally content. Japan's success seems to rest on the fact that lower level workers are involved in the day to day decision making process. Quality circles, Japanese management style, and Theory Z are being borrowed from the Japanese and applied to American industry.

In order for this infusion of Japanese influence to be successful, American industry will have to make some adjustments. At the time of the Industrial Revolution, industries assumed an organizational structure similar to that used by the military and the church. These structures had been successful and effective since those times. It was logical for American industry to be organized in a similar manner. The hierarchy of jobs, chain of command, and easily identifiable rank as indicated by dress were associated with these organizations and copied by American industry.

The Japanese management style seems to offer the best promise for resolving the problems of worker discontent. If this philosophy is adopted by American manufacturers, both management and workers will have to assume new roles. Workers will have to be familiar with their jobs and also with how their jobs affect and are related to the rest of the functions of the company.

If the industrial arts curriculum is going to be successful in preparing students for future roles in industry, it will have to become much broader in the interpretation of his/her future role within the company.

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[illegible] Industrial Estate

[illegible] Standards and Exercises

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Industrial area is not [illegible] a [illegible] but rather a [illegible] provided to a [illegible] of [illegible], [illegible] [illegible] [illegible].

[illegible]: In [illegible] of the report by the [illegible] for Industrial [illegible] [illegible] project of [illegible] [illegible] and [illegible] [illegible] [illegible] [illegible]. The [illegible] guides for industrial [illegible] [illegible] [illegible] [illegible], [illegible] [illegible] by the [illegible] to [illegible] and [illegible] [illegible] [illegible]

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(a)	1	[illegible]	[illegible]	[illegible]
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